JPRS-USP-86-001

13 January 1986

USSR Report

SPACE

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FEOKISTOV REVEALS DETAILS OF 'SALYUT-7' REACTIVATION

Moscow PRAVDA in Russian 5 Aug 85 pp 3, 8

[Article by Professor K. Feokistov, Hero of the Soviet Union: "The Courage of the 'Pamirs'"]

[Text] Vladimir Dzhanibekov and Viktor Saninykh have been working for two months aboard the Salyut-7 station. The Soviet cosmonauts have conducted a series of scientific and technical experiments, received two cargo ships and this past Friday completed an excursion into open space. The 'Pamirs' have been working under difficult conditions - the beginning of their expedition was indeed unusual.

After the work of the third primary expedition on board the orbital complex Salyut-7 and Soyuz T-12 was completed, from October 2nd 1984 on the station was in automatic mode. It was temporarily closed down and, over the course of five months, periodic radio contact was used to monitor it.

In a routine check a problem in one of the units of the station's radio system, through which commands from the Earth pass, was discovered. As a result, radio contact from the station ceased and it became impossible to obtain telemetry information on the condition of the station's on-board navigation systems. This meant that it was impossible to monitor the position of the station in orbit by radio signals or to understand the character of its movement about its center of mass and that the station's maneuvering apparatuses and motors could not be used for approach and docking with transport spacecraft. Accordingly, using the well mastered technique of automatic approach of a transport spacecraft to the station became impossible as was monitoring the operations and conditions of the station's on-board systems, such as the thermal regulation system, electrical power supply system and the system for maintaining the composition of its atmosphere.

It became clear that in order to restore normal operation it would be necessary to have a crew on board. But to do this a scheme had to be worked out for guiding a transport ship to the silent station at an undetermined point in the expanse of space, to prepare a ship and crew for the flight and for performing this unusual task, to outfit this ship with

the new equipment needed for such an operation, to work out a new ballistic path for the approach and to train the specialists of the Flight Control Center. The following technology was developed in order to approach the station: from a distance of approximately ten kilometers the crew, with the help of an optical device, had to align one of the axes of their ship with that of the station (which over the illuminated side of the Earth should be observable against a background of black sky as an unusually bright star - if, of course, the station is approached from the Earth side) and enter into an on-board computer the selected axis of the ship which, at the given moment, is "looking at" the station.

Several such "marks" are entered into the memory of the on-board computer, which "knows" at each moment the actual position of the ship in a "fixed" coordinate system. These marks provide information about the true trajectory of the ship's passage close to the station, permitting it to perform the necessary calculations and issue commands to correct this trajectory for the purpose of leading the ship to the station.

At a distance of two to three kilometers from the station, if the approach has been going normally, the crew has to take manual control, draw closer to the station and circle around it in order to approach it from the side of its transfer compartment and dock.

To carry out these maneuvers, besides the necessary mathematical algorithms, calculations and operations, which are entered into a computer's memory, an array of instruments was prepared which included an optical aiming device, a laser range-finder and an instrument for night vision. This last item they decided to take in case they couldn't succeed in docking with the station before it entered into shadow and it became necessary to "hover", that is to maintain a selected distance from the station so as not to lose sight of it or collide with it while in shadow. Starting in March they began to ready a ship. They developed techniques, plans and programs of operation for the crew and Control Center to accomplish the approach, the fly-around and the docking of the ship with the station. Special training of the crew was conducted on various simulators and they were prepared to work with an array of equipment new to them. The personnel of the Control Center, of all the ground services and of the observation, control and communications points were trained. Plans of action for the crew after the docking of the ship with the station were also worked out.

On 6 June the spacecraft Soyuz T-13, manned by V. Dzhanibekov and V. Savinykh, was put into orbit. After corrections to its orbit were completed, on the morning of 8 June the spacecraft approached the station. When the ship and station exited from shadow they were at a distance of about ten kilometers from each other. V. Dzhanibekov aligned the ship's lateral axis with that of the station, observing it through the porthole of the ship's descent craft while V. Savinykh entered data into the computer according to Dzhanibekov's commands. At a distance of two and one half kilometers the automatic equipment executed the last correction maneuver and the crew took manual control. By the way, the calculations of the on-board computer were accurate enough that the corrections to the approach trajectory that had to be made manually were insignificant.

At a distance of about 200 meters the ship was put into a "station keeping" mode by its crew - i.e. it ceased closing with the station, holding itself a selected distance away from it. The crew evaluated the lighting conditions under which the station would have to be approached (they were not very favorable), conferred with the Control Center and received permission to go ahead with docking. V. Dzhanibekov moved the ship closer, circled the station, brought the ship toward the station's transfer compartment and performed the docking.

The wonderfully executed approach and docking operation with the Salyut-7 station can be evaluated as a major technical achievement. This technique has great significance for the development of manned space flight. It will become possible to accomplish an approach to satellites to carry out visual inspection or necessary repairs and maintenance work. Still more significant is the operation's application in rescuing the crew of a manned vessel which cannot return to Earth for technical reasons.

Both the crew and all who participated in the preparation and execution of this flight were glad and happy. Their accomplishment - one might even say their victory - was unquestionable but in the clear heavens a small cluod had appeared. During the Soyuz T-13's approach to the station on the television image in the Flight Control Center they noticed that the two coaxial solar panels weren't parallel but rather an an angle of about 70 to 90 degrees relative to each other. That meant that the solar battery orientation system was not working and there could be an absence of voltage in the electrical power supply system.

After hooking up the electrical connectors of the station with the ship it was necessary to check those parameters of the station which are monitored in the process of checking the station's pressure-tightness and for the transfer between the ship and the station. Connecting the station's sensors to a display on the ship was accomplished through the docking system electrical connectors. They were convinced: the station's sensors didn't connect to the ship's circuit but their switch was supposed to be fed from the station's electrical power supply system.

Immediately many problems arose: if the electrical power supply system wasn't working, then the station and everything inside it would have frozen. Not only food and water, but also instruments, assemblies and mechanisms which are designed to operate at temperature above freezing. This meant that the system for providing and monitoring the atmosphere inside the station wasn't working and, consequently, it was unclear whether the crew could stay inside it. What the atmospheric contents were inside was unknown: a malfunction in the radio circuits could also have been explained by a fire. It was possible that the crew would have to use respirators...

Before entering the work compartment of the station a pressure equalizing valve was opened and a device brought from Earth was set up to take a sample of the air inside the station for analysis of its contents because the station's atmosphere had not been monitored from Earth recently. The analysis performed by the crew showed that harmful traces and toxic substances were absent from the station's atmosphere. After this, the

cosmonauts opened the hatch and proceeded into the station's work compartment. The temperature in the compartment was below zero on the Celsius scale.

While still in the transfer compartment V. Dzhanibekov tested the voltage in one of the sockets - it equaled zero. Their worst fears had been confirmed. Nevertheless, they tried to issue commands from the station's control panel in the station's working compartment - it didn't work. They looked at the capacity indicators for the storage batteries of the station's electrical supply system - capacity was zero.

What had happened? What condition was the station in? How could they work in the station - without the station's atmosphere being cleaned (yet the air regeneration system couldn't be turned on because there was no voltage). With a crew inside, in roughly 24 hours the concentration of carbon dioxide would rise to dangerous level. Yet they had to work - otherwise there was no way to determine what happened and what to do further. On recommendation from the ground, the crew assembled a temporary ventilating system. They switched on the first generator.

Problems, like a mountain, grew before the engineers on Earth. First the power supply system had to restored. Was this theoretically possible? Before the launch of the Soyuz T-13 the specialists on the power supply system categorically maintained that if the system broke down and the batteries were completely discharged, then to restore its capacity to operate would be impossible. But now, in the actual situation, it was necessary to seek a solution and to resolve all the problems of reactivating the station.

Judging from the fact that even when illuminated the solar panels weren't applying voltage to the bus-bars of the power supply system, the solar panels were disconnected from the power storage batteries. The first task was to connect the solar panels to the bus-bars of the electrical power supply system in order to restore and recharge the power storage batteries. But in order to do this voltage had to be applied to the winding of the remote automatic switch rather than the manual one - yet there was no voltage. A closed circle. It was impossible to apply voltage from the ship because of the possibility of a malfunction in the station's electrical circuits which could disable the ship's electrical power supply system and prevent its release from the station. Return to Earth would become impossible. No - the life of the crew could not be risked.

A rather complex procedure for restoring the station's electrical power supply system was found and implemented. According to routines worked out on Earth the crew figured out a plan to connect the station's storage batteries to the bus-bars. By means of continuity tests it was determined which battery cells were malfunctioning and these were excluded from further operation. Fortunately, there weren't too many of these - two out of eight. It could be hoped that the remaining batteries would accept a charge if connected directly to the solar panels. Following instructions from Earth the crew prepared the cables needed for the connection. On 10 June charging of the first battery was begun.

Using the spacecraft's guidance control system and its maneuvering engines, the station was oriented so that the connected solar panels were illuminated. In a few hours the first block was partially charged. They connected this to the bus-bars of the station's electrical power supply system. After this it became possible for the cosmonauts to switch on the station's telemetry system from the control panel and from the information received on Earth to evaluate the condition and temperature state of the space station's systems and assemblies.

There were many problems. Not only the power supply system troubled us, but also the temperature of the construction elements was near zero and below. This meant that the maneuvering motors could not be operated. The water on the space station had frozen. On the second day V. Dzhanibekov and V. Savinykh had already attempted to turn on the "Rodnik" water supply system - it didn't work. And when would it be able to warm up? According to calculations it could take from several days to months. Water reserves on the Soyuz ship were sifficient for eight days, that is they would run out on 14 June. Even using the station's two small portable tanks wi h frozen water, having warmed them beforehand on the ship, limiting the crew's consumption and using water from the ship's emergency supply, the water would last only until 21 to 23 June.

But the "warming-up" began early. After the first battery was charged, they charged the remaining ones in the same way. In the process of working with them the reasons for the breakdown of the electrical supply system became clear - in one of the batteries there was a malfunctioning sensor which indicated the battery was fully charged. Acting on the signal of this sensor the solar panels stopped recharging the power storage batteries. According to the commands of a time-program device, the order to connect the solar panels was given once every orbit, but the malfunctioning sensor kept disconnecting them. The chemical batteries continued to be drained by the load of the equipment and gradually discharged to zero. The entire apparatus of the space station ceased working - there was no power supply.

Without the equipment functioning there was no heat and the station began to cool and then freeze. This wouldn't have happened had there been a crew on the station or if radio contact with Earth hadn't ceased - the malfunctioning sensor could always have been shut off via radio commands.

After charging the reserve batteries, V. Dzhanibekov and V. Saninykh restored the normal electrical system and the power supply, and the system which aligns the solar panels, the thermal regulation system and the telemetry system began to operate. The crew established a working radio command link and light and heat appeared. On 16 June the "water ran" and the ice in the "Rodnik" system began to thaw. The crisis was over.

In warming up the station certain care had to be taken because when the station cooled off its atmosphere's moisture must have evaporated and then frozen on the walls of the space station. Therefore, they couldn't switch on the thermostat circuit immediately. If they did the mositure would evaporate from the walls and condense on the cold instruments and electrical

connectors and lead to disturbances in their operation. Therefore, they first warmed the space station's inside atmosphere and only afterwards turned on the thermostat circuit for the station's hull.

By 13 June they ran a test on the orientation system, the approach equipment and the motors. If they hadn't worked it would have been impossible to dispatch a cargo spacecraft - one could approach the space station only operating in automatic mode and working together with the station's automatic system. In this event the crew would have to return to Earth, cutting short their expedition. The test went normally.

A decision was made to quickly prepare the launch of a cargo spacecraft whose main assignment would be to furnish water to the space station. It was necessary to test, fuel and prepare a spacecraft and its booster rocket for launch in the fewest possible days. At dawn on 23 June Progress-24 docked with the space station.

Of course, the space station's equipment had undergone a difficult ordeal. Therefore, after the restoration of the electrical power supply system it was necessary to perform other repair and maintenance work which had been planned earlier.

Progress-24 supplied new chemical batteries, with part of the old ones already operating, and water as well as fuel and the equipment needed for further manned flight.

It must be said that Vladimir Dzhanibekov and Viktor Savinykh, having shown true courage under very difficult conditions, carried out all the operations for reactivating the space station with great care. The selfless work of the personnel of the Control Center and all the engineers who took part in analyzing the situation and developing the programs and methods to restore the space station's capacity to operate, cannot be left unmentioned. In the course of the flight's first month, unique data and experience were obtained on restoration work in space and the possibilities for accomplishing such complex repair operations. The space expedition on board Salyut-7 continues. Vladimir Dzhanibekov and Viktor Savinykh have successfully completed the planned flight program. The space station is operating normally.

12961/9835
CSO: 1866/108

ADDITIONAL DETAILS ON REMANNING OF 'SALYUT-7'

Moscow IZVESTIYA in Russian 10 August 85 p 3

[Article by Izvestia Special Correspondent A. Ivakhnov "Well Done 'Pamiry': Report from Mission Control Center"]

[Text] Vladimir Dzhanibekov and Viktor Savinykh have been working on board the orbiting space station Salyut-7 for more than 2 months, doing complicated repair and restoration work, receiving two cargo ships, conducting scientific studies, technical experiments, and doing assembly work in space. "We will do everything possible," said the cosmonauts before launch. They almost did the impossible.

The scheduled contact between Mission Control Center and the orbiting scientific station has ended. Reports from the Center's working group managers are heard on the loudspeakers: on board, all systems are functioning normally; there are no remarks on crew health; the cosmonauts are ready to conduct the scientific experiments planned for the next orbit. How many times we have heard similar reports, last year and the year before that. But in truth, we didn't always pay attention--there was nothing special, just the standard formalities. Now I am trying to record everything word for word in my notebook because...Well, you'll understand for yourselves why.

When the "Pamiry" were launched, they were to perform a unique operation. Because of a malfunction in one of Salyut-7's radio units, Mission Control had stopped receiving telemetry information from the station. What had happened? They could find out only by being on the Salyut-7. This assignment was given to Vladimir Dzhanibekov and Viktor Savinykh.

Their first priority was to dock with the silent station. Ballistics specialists developed a system to orbit the ship and make it approach and dock with the spacecraft, although no one knew how the spacecraft was oriented in space. The Soyuz T-13 was equipped with the newest instruments -- laser rangefinder, optical guidance system. It was assumed that before docking, the ship, equalizing its speed, would "hover" 200 meters from the station to allow time for consultation and thinking. A night vision device was installed on the ship in case it hovered in the Earth's shadow. If the cosmonauts saw that the distance was shrinking, they could turn on the engines and move away a little. If the Salyut-7 moved away, they could also catch up to it.

Suddenly the "Pamiry" were 4 kilometers from the station.

"Well, what condition is it in?" worried Mission Control.

"Turned with its side to us. The solar batteries are not rotating. They are standing still."

On the TV screen the Salyut-7 rotated, turning its docking assembly toward us. In fact, the Soyuz T-13 had flown around the orbiting station and assumed a position convenient for docking.

At Mission Control, applause erupted: docking was accomplished on the first try. Vladimir Dzhanibekov had proved himself a genuine ace space pilot. But it was still early to celebrate victory, since no one yet knew what was behind the docking assembly.

Using a device brought from Earth, they "sniffed," as they say, the atmosphere within the station through a pressure equalizing valve. It turned out that there were no harmful contaminants. Apparently, there had been no fire on the Salyut-7. They opened the hatch to the working compartment.

"It's cold," report the cosmonauts. "We can't work without gloves. There is frost on metal surfaces. It smells of stagnant air. The station is in perfect order, but nothing is working. The genuine silence of space."

"Have you put on warm underwear, flight suits, thermal boots, and down caps?" ask the doctors. "There might be stagnant compartments in the station with high carbon dioxide content. If you find it hard to breath or get a headache, get back into the craft and tell us. There is still no ventilation, and you can work in the station only one at a time, remember?"

"Of course," answers V. Dzanibekov, "That's what we are doing." And now V. Savinykh's voice is heard.

"Volodya, come here a second. Help me."

Before they were launched, dozens of possible alternatives were considered and simulated on trainers. Even the worst case was included: that the station was hopelessly dead. In this case, the "Pamiry" were to discover the reason for the malfunction and return home. They discovered the reason. The station was switched off, the batteries discharged. However, they were entirely functional. Only two of the eight batteries had malfunctioned. The "Pamiry" connected those remaining consecutively to the solar batteries. Then using the Soyuz T-13's engines, Vladimir Dzhanibekov turned the station so that the battery panels received maximum illumination from the sun. Electric "blood" began to flow and then pulse in the station's wires.

We probably will still question the "Pamiry" a little and then tell you how Vladimir Dzhanibekov and Viktor Savinykh with flashlights in hand revived the Salyut-7 ("Without gloves your hands get stiff, but with gloves you can't do much. It's like repairing a car in an intersection on a freezing cold night.") How they floated to the Soyuz T-13 to get warm. How they made notes on their sleeves because they didn't want to waste time "running" to the craft for their logs. How they gradually thawed out the station ("We are breathing steam. There are drafts from the fans. Oh, it's cold...").

And then the annoyance that the "Vesna" tape recorder didn't work, and there wasn't enough music in the cosmic silence. It would seem that Dzhanibekov, a radio hobbyist, could fix the malfunction. Compared to the other problems, this was child's play.

"Fixing it is easy," says the cosmonaut. "But when can I get to it? Maybe by the end of the flight. But, understand, we need music so badly now..."

And later:

"The warmer it gets, the damper it gets." We need a lot of dry rags and a bucket. I'm joking of course...."

I'm turning the pages of my notebook and again reliving my involvement in the joy of the Mission Control specialists, when the solar batteries started to work, when telemetry data began to reach Earth from the station, when electric light flooded the station ("Wow!"). Then the TV screen flashed, and we saw healthy and happy cosmonauts.

They had done everything possible, and even more, and are continuing their difficult service. They have to unload Cosmos-1669, photograph a large area of the Soviet Union on request from our economic specialists. Fortunately the lighting is good, and the weather favorable. New scientific equipment, delivered by cargo craft, is prepared for operation.

Thanks to the self-sacrificing labor of the "Pamiry," the Salyut-7 is alive and healthy. Thanks to additional solar batteries installed several days ago by the "Pamiry," the station is now warm inside, and there are no obstacles to carrying out the scientific program. Now the long-range planning group is confidently augmenting the "Pamiry's" flight program with operations scheduled in the maximum program.

A new contact is starting. The "Pamiry" report that they have prepared the instrument for one of the experiments ahead of schedule.

"Well, guys, you did fine!" the on-duty manager praises them. And indeed, they did do fine!

12890
CSO: 1866/109

PREPARATION OF COSMONAUTS FOR 'SALYUT-7' REACTIVATION MISSION

Moscow PRAVDA in Russian 7 Sep 85 p 3

[Article by USSR Pilot-Cosmonaut, twice Hero of Soviet Union G. Bergovoy, and USSR Pilot-Cosmonaut, Hero of the Soviet Union Yu. Glazkov: "'We Had Faith in Success!'"]

[Text] Soviet cosmonauts Vladimir Dzhanibekov and Viktor Savinykh have been working in orbit for 3 months. Many collectives of specialists are supporting work of the fourth long expedition aboard the Soviet orbiting station Salyut-7. This is our story of how the crew was prepared for this difficult flight.

On that day the Cosmonaut Training Center imeni Yu. A. Gagarin was living its usual concerns about future flights. There were no emissaries from Zvezdnyy in space at this time: The Salyut-7 station was flying in automatic mode. But here at the Cosmonaut Training Center, space crews were "flying": They were preparing on trainers for the next--fourth--main expedition to Salyut-7.

But suddenly alarming information was transmitted to the communications officer from Flight Control Center: Radio communication with the station was interrupted, and telemetry on the status of its systems was no longer being delivered. As new data and additional details on the nature of the failure came in, the hopes for a favorable outcome continually decreased.

But no one would or could agree with the idea that the station had been irretrievably lost before it had served its useful life. There was but one solution: The station had to be "returned to life." That meant that a crew had to fly to the station. There were no alternatives. They all understood this, and they understood that the crew would have to work in extremely difficult conditions, that all of its actions must be oriented on achieving success and on maintaining the crew's own safety. And this meant that the crew had to be well prepared. What facts did the specialists possess? Most importantly, the station was uncontrollable, rendezvous by means of radio systems was impossible, and there was no way to turn on the station's propulsion units, meaning that automatic docking was also impossible. All hopes rested on man. But man must first possess information on the position of the station, on the parameters of the relative motion of the ship and the station. This means that instruments that could acquire such information had to be created.

The appropriate instruments were selected: a laser rangefinder and a night vision instrument (for work on the dark side of the orbit). Changes were made in the controls with regard for the additional instruments to be carried. This entire complex was installed in the trainer.

Ballistic experts calculated the theoretical possible rendezvous trajectories from points far away from the station. These data were fed into the trainer's computer complex. Thus an integrated rendezvous, approach and docking model was created.

A group of cosmonauts having experience in automatic and manual docking during space flights were selected to practice the procedures. Day after day the instructors, cosmonauts and developers worked: The procedure was slowly created and refined. The question "But what if?..." was the one asked most frequently. But what if sunlight was blinding? But what if there was not enough time for docking before entering the shadow? But what if.... Experience accumulated, the work procedures improved, and confidence in the correctness of the decisions grew. The method of preparing the crews, based on practicing so-called "unusual situations," is widely employed at the Cosmonaut Training Center. And the trainers are designed in such a way that such situations could be created in them. The experience of all previous space flights was concentrated in this method. It became the principal method in the situation at hand.

There were many candidates for flight. Two were selected--Vladimir Dzhanibekov and Viktor Savinykh, and alternates were chosen. This would be the fifth flight for Vladimir Dzhanibekov. He had considerable training experience in rendezvous and docking procedures, he had experience in automatic and manual docking in space, and he was a veteran of extravehicular activity, which also had great significance. Prior to this, Viktor Savinykh completed a 75-day flight aboard Salyut-6.

The cosmonauts and specialists trained diligently, and the piloting techniques were honed to truly jeweler's precision. One procedure after another, one docking after another. The computers processed the results, dispassionately assessing the labor of the people. The instructors continually introduced new difficulties, and fabricated failures of different instruments. And the cosmonauts were able to handle them.

It was evident from the training records, from the computer analysis read-outs and from discussions with the instructors that the crew's proficiency was growing from one day to the next: Quiet, pensive Vladimir and lively, active, rather expansive Viktor. The psychologists and physicians were invisible crewmembers during the training, analyzing the crew's speech, emotions, the content of simulated transmissions to earth, pulse, respiration -all that fits within the concept of the psychophysiological background. Their recommendations were heeded during the learning process.

Mistakes were made at first. Then they became fewer and fewer. The crew learned to fly with the new instruments, using the new procedure, in the new conditions. The beam of the laser instrument was like an extremely thin needle that had to make contact with the station in order to determine the

range to it. This also the crew had to learn how to do, which meant more training. As a result, out of a hundred attempts, a hundred were successful!

Docking was to be only one of the stages of the forthcoming difficult flight. Let us assume that docking was successful; what happens next? Many versions of what was to happen were developed, they were tested on stands, and they were modeled with the real apparatus and in computer complexes. A training mock-up of the Salyut station, a water tank, and various testing stands and devices were used to prepare the crew. The experience accumulated in repairs and assembly operations carried out previously in space was accounted for completely.

As on earth, energy is the basis of everything aboard a spacecraft. When there is energy, the object lives, when there is no energy, cold space makes it lifeless.

Of course, it was impossible to foresee everything. There were other opinions as well--that it is impossible to revive the station. But only flight, only work in space could give the correct answer. Still, most had faith in success.

Joint training between the crew and specialists of Flight Control Center demonstrated complete mutual understanding. Inasmuch as Flight Control Center did not have information on the station, the bulk of the work of rendezvous, approach and docking in the final stage and the principal decisions were delegated to the crew, resting on its ability and preparedness. Flight Control Center specialists made preparations to forecast the rendezvous on the basis of data communicated to them by the cosmonauts. The interaction procedures were unusual, and they required maximum attentiveness and efficiency during the processing of the information and its analysis.

Then came the day of the launching. Everyone understood the importance of the coming moments. The great effort of the large collectives was to be completed by two--the commander and the flight engineer of Soyuz T-13.

All were touched by words addressed to the cosmonauts by our famous pilot, three-time Hero of the Soviet Union I. N. Kozhedub: "Have a good trip, my sons, this is Ivan Kozhedub talking to you, who knows well what it means to embark upon a combat mission. And that is precisely what you are facing now. I know that you have been given a job of unprecedented difficulty, one which will require all of your abilities, courage and will.... I believe that you will do everything to complete your mission. Just like us, the pilots of wartime, you have been indoctrinated by our party, the people and all of our Soviet reality."

The lift-off and subsequent correction of the orbit were flawless: Specialists of the launch complex and ballistics experts once again demonstrated their proficiency. The crew acted confidently and error-free during rendezvous and docking.

The cosmonauts transferred into the station: Frost had formed on the portholes, and the temperature was around zero, and perhaps even lower. The warm clothing they brought along specially for this eventuality served its purpose.

The work began immediately. Checking out the system gradually, step by step, they made their way to the cause of the failure in the power supply system. They checked one block after another, and found that some were no longer fit for the work--time and cold had done their job. On the fifth day, the meticulous work of the cosmonauts began to bear its fruits: One battery and then another started to recharge. The station came back to life, as if after a deep sleep. The regenerators and filters started working, and the console lights began blinking. Temperature measurements were started: The temperature was f.·m 2.5 to 5° at different points in the station. One after another the systems returned to life: The radio communication system recovered its "voice," the teletype started drumming, the temperature climbed, water thawed, and life aboard the station gradually returned to normal. The station's control system was restored, the possibility for docking with cargo craft was insured, and the scientific portion of the flight program could be started.

Once again rockets were positioned on the launch pads, and once again the command "Lift-off!" was given. Progress-24 headed for orbit, followed by Cosmos-1669, to deliver cargo to the station necessary for its repair and for the flight's scientific program.

The flight of the "Pamir" complex once again demonstrated to all peoples of the earth the peaceful goals of the Soviet space program, the courage and heroism of the Soviet people, and the high professional training of Soviet cosmonauts.

11004
CSO: 1866/126

SHATALOV COMMENTS ON REACTIVATION OF 'SALYUT-7'

Moscow KRASNAYA ZVEZDA in Russian 28 Sep 85 p 4 and 29 Sep 85 p 4

[Article by V. Shatalov, General-Lieutenant of Aviation, pilot-cosmonaut of the USSR, director of training of Soviet cosmonauts]

[Abstract] The two-part article recounts the planning and carrying out of the mission of "Soyuz T-13" cosmonuats Vladimir Dzhanibekov and Viktor Savinykh to restore the disabled "Salyut-7" station to working order.

Recounting the circumstances of the discovery that the station had become totally disabled and of the decision to send up a crew to restore it if possible, the author points out that the key technical problem involved the one of rendezvousing and docking with a spacecraft entirely without feedback from it. He recounts how he personally had helped to formulate the basis for such an operation. The author recalls that during his own flight aboard the "Soyuz-4" spaceship, which linked up with the "Soyuz-5" ship, he began thinking about the possibility of the crew assuming manual control of the ship not only in the final stages of the rendezvousing process, but also when the spacecraft were far apart. It occurred to him that in the event of failure of spacecraft's automation, crews could still be able to link up, which would provide an important reserve capability for the space program. The author recalls that subsequent missions on the "Soyuz-8" and "Soyuz-10" ships provided him with more food for thought on this problem. He discussed it with spacecraft designers, and began working on technical solutions, which he subsequently formulated in a dissertation. It led to methods for practicing manual control procedures on simulators at the Cosmonaut Training Center. The author says this background was important to the planning of the recovery mission, because it provided a reliable basis for carrying out a link-up with a disabled spacecraft.

The author goes on to recall three main tasks that had to be solved once the decision to send a recovery mission was made: outfitting the spaceship to be able to accomplish manual rendezvousing and docking, selecting the best-suited cosmonauts for the crew, and ensuring the safety of the crew. He relates how the choice fell on Dzhanibekov because of his experience in four missions that involved docking with "Salyut" stations, and on Savinykh because he is a skilled engineer (candidate of technical sciences) who had worked on board orbiting complexes. They and their back-up crew began training for the mission in March. They practiced using the optical guidance

instrument, laser range finder, and night vision device with which their spaceship was equipped for the mission.

The author goes on to recount the mission itself. He notes that when the crew flew around the "Salyut-7" station, they found the panels of its solar batteries were not parallel as they should have been, but were turned at an angle of 70-90 degrees. This gave them and ground specialists valuable information about the situation on the station.

It is mentioned that Savinykh and the two members of the "Soyuz T-14" crew who are currently aboard "Salyut-7" are in fact the three cosmonauts who were preparing for the next regular primary expedition on the station before it became disabled.

FTD/SNAP/9835
CSO: 1866/38

COSMONAUTS INSTALL ADDITIONAL SOLAR BATTERY PANEL

Moscow IZVESTIYA in Russian 4 Aug 85 p 1

[TASS Report]

[Text] Flight Control Center, August 2. The latest stage in the assembling and installing of large structures in open space has been carried out.

In line with the mission program, Vladimir Dzhanibekov and Viktor Savinykh made an egress onto the outer surface of the orbiting scientific station "Salyut-7" and installed extra panels on the station's third solar battery. These panels had been delivered by the cargo spaceship "Progress-24". All three of the station's solar batteries are now equipped with sets of extra sections, which are connected to the manned complex's unified power-supply system.

During the development of the "Salyut-7" station, provision was made for installing extra solar-battery panels for the purpose of gradually increasing the station's power resources. The first stage of this work was executed by Vladimir Lyakhov and Aleksandr Aleksandrov in November of 1983 and the second stage by Leonid Kizim and Vladimir Solovyev in May of 1984.

The egress of Vladimir Dzhanibekov and Viktor Savinykh into open space began today at 1115 hours Moscow time. Necessary equipment in containers was taken by the cosmonauts to the zone where they were to work. The cosmonauts then installed the first extra panel of the solar battery and placed it into operating position, using special tools, mechanisms and fastening devices.

Next, the solar battery was rotated 180 degrees in accordance with commands from the Flight Control Center, and the cosmonauts installed a second panel. They then fastened an experimental prototype of a solar battery to one of the main panels, for the purpose of studying the effect of conditions of open space on this battery.

After completing the installation operations, the commander and flight engineer returned to the exit hatch. They installed, in the zone of this hatch, apparatus which was developed jointly by Soviet and French specialists and is intended for gathering meteoritic matter in outer space, and they

replaced scientific equipment, specimens of biopolymers in holders, and various structural materials.

Dismantled units and instruments that have been on the outer surface of the station for a long time will be returned to Earth for subsequent studies in design organizations and institutes of the USSR Academy of Sciences.

Space suits of the semirigid type whose design has been improved were tested in the course of the egress. These suits were modified with the open-space work experience of previous crews of "Salyut" stations taken into account.

Vladimir Dzhanibekov and Viktor Mavinykh went back inside the station after completing the planned operations.

During the entire egress, whose total duration was five hours, electrocardiograms of both cosmonauts were recorded on magnetic tape, and a number of other physiological parameters were recorded, using portable medical apparatus. The information obtained will be used to evaluate the state of health and working fitness of cosmonauts at various stages of periods spent in open space.

During the performance of these intricate installation operations, the crew displayed high professional skill and courage and operated smoothly and confidently in close collaboration with specialists of the Control Center.

The condition of Vladimir Dzhanibekov's and Viktor Savinykh's health is good, and they are feeling well.

This complex experiment, which was accomplished successfully, once again confirmed the correctness, in the development of manned orbiting complexes intended for multiple scientific and economic purposes, of engineering solutions and methods for assembling large structures in conditons of outer space.

FTD/SNAP/9835
CSO: 1866/38

COMMENTARY ON COSMONAUTS' EVA

Moscow PRAVDA in Russian 3 Aug 85 p 3

[Article by A. Pokrovskiy, special correspondent at the Flight Control Center]

[Abstract] The article reports on activities at the Flight Control Center during the egress of cosmonauts Vladimir Dzhanibekov and Viktor Savinykh from the orbiting station "Salyut-7" on 2 August.

Mention is made of details of operations which the cosmonauts performed and features of the new space suits which they wore during the egress. As compared with suits used during earlier missions, the new space suits are said to be designed with illuminated control units and improved shoulder belts. The new belts make it possible to expand the area in which cosmonauts can work outside the station. A portion of the rubber shell is replaced by a rubberized fabric that is sturdier, in the redesigned suit.

Deputy flight director G. Oganesyants praised the crew's performance of work on the station's solar batteries. An extra battery which the cosmonauts installed is said to be 4.5 meters long and 1.2 meters wide when unfolded. A meteoric-dust collector which the cosmonauts placed on the outside of the station was prepared by Soviet and French specialists. This instrument reportedly is to be used in connection with the upcoming space probe of Halley's Comet. The instrument collects dust by means of flaps. A portion of the flaps open when a comet approaches the Earth. These flaps are subsequently deactivated, and another set of flaps is opened for background comparison of the comet's effects. Results thus obtained can be compared with data gathered by "Vega" spacecraft in the immediate vicinity of Halley's Comet.

FTD/SNAP/9835
CSO: 1866/38

FEATURES OF NEW SPACE SUITS

Moscow IZVESTIYA in Russian 4 Aug 85 p 2

[Article by A. Ivakhnov, special correspondent at the Flight Control Center]

[Excerpt] Work on building up the solar batteries of the orbiting scientific station "Salyut-7" has been completed.

Extra panels in containers were delivered to the station's crew by the cargo spaceship "Progress-24". Two new suits for work in open space came, together with other cargo items from Earth, on the next transport ship, "Cosmos-1669". Every wish of participants in previous egresses, including Vladimir Dzhanibekov, was taken into account in the making of these space suits. It is easier to move in them, and small but very bright lights are installed on their headsets, at the temples, so that instrument readings can be monitored more conveniently in the darkness of outer space. The controls of the space suits are also improved. These new 'personal spaceships' are made of stronger materials, and they are equipped with shields which protect their headsets against accidental impacts.

"Cosmos-1669" also brought scientific equipment which the cosmonauts were to install outside the station. A meteor-dust collector developed by Soviet and French specialists was delivered to "Salyut-7", as well as test specimens of structural materials in a holder.

FTD/SNAP/9835
CSO: 1866/38

TASS REPORTS COSMONAUTS COMPLETE TWO MONTHS IN ORBIT

Moscow IZVESTIYA in Russian 7 Aug 85 p 1

[TASS Report]

[Text] Flight Control Center, August 6. The mission of Vladimir Dzhanibekov and Viktor Savinykh in near-Earth orbit has been in progress for two months. During this time, they have done complex repair and reconditioning work on the "Salyut-7" station in the course of putting it into the manned-flight mode, and they have performed a considerable number of scientific and technical experiments. The cosmonauts have received two automatic transport spaceships; last Friday, they made an egress into open space and installed extra solar batteries.

Yesterday, the crew performed its latest series of geophysical studies in the interests of science and various branches of our country's economy. Regions in the south of the European part of the Soviet Union's territory, the Caspian lowland, the area between the Amu Darya and the Syr Darya rivers, Lake Baykal and the Far East were photographed with the aid of the stationary cameras MKS-6M and KATE-140.

While performing research and experiments on board the orbiting complex, the cosmonauts at the same time are continuing the unloading of the satellite "Cosmos-1669". The cosmonauts have installed in their permanent places a portion of the cargo items that were delivered, and they have pumped water into tanks of the station.

In line with the biological research program, an experiment for forming a polyacrylamide gel by means of photoinitiation will begin today in the "Svetoblok-T" unit.

The flight of the manned complex "Salyut-7"--"Soyuz T-13"--"Cosmos-1669" is proceeding normally.

Cosmonauts Vladimir Dzhanibekov and Viktor Savinykh are healthy, and they are feeling well.

FTD/SNAP/9835
CSO: 1866/38

RADIATION BELT, NUCLEIC ACID STUDIES ON 'SALYUT-7'

Moscow PRAVDA in Russian 10 Aug 85 p 1

[TASS Report]

[Text] Flight Control Center, August 9. Cosmonauts Vladimir Dzhanibekov and Viktor Savinykh have been working in near-Earth orbit for 65 days.

During the days just past, the crew performed geophysical and technical experiments and worked on preparing scientific apparatus for upcoming studies. An additional series of visual observations of an agricultural survey area and of photography of the area with hand-held cameras was carried out in line with the second stage of the large-scale international experiment "Kursk-85".

In line with the medical monitoring plan, measurements were made of height and body mass, and the cosmonauts evaluated the conditon of muscles that are not exerted much in conditions of zero gravity.

Today's schedule on board the complex calls for astrophysical and geophysical studies, preventive maintenance measures on the station, and physical exercise.

With the aid of an instrument called "Mariya", which was delivered to the station by the satellite "Cosmos-1669", an experiment is being conducted for the purpose of studying mechanisms of the generation of high-energy particles in radiation belts of the Earth and of near-Earth space.

An experiment with synthesizing components of nucleic acids in conditions of open space is continuing. An instrument called "Meduza", which contains specimens for study, was installed on the outer surface of the "Salyut-7" station during the egress of Vladimir Dzhanibekov and Viktor Savinykh on 2 August 1985.

The flight of the orbiting complex "Salyut-7"--"Soyuz T-13"--"Cosmos-1669" is proceeding normally. The condition of both cosmonauts' health is good, and they are feeling well.

FTD/SNAP/9835
CSO: 1866/38

COSMONAUTS PARTICIPATE ON 'GYUNESH-85' EXPERIMENT

Vilnius SOVETSKAYA LITVA in Russian 14 Aug 85 p 1

[TASS Report]

[Text] Flight Control Center, August 13. The space mission of Vladimir Dzhanibekov and Viktor Savinykh is continuing on board the orbiting scientific station "Salyut-7".

Today the crew is taking part in a large-scale experiment, "Gyunesh-85", which is being conducted within the framework of an extensive program for the study of the dynamics of geosystems by remote methods. This experiment is being performed in the area of the Caucasus-Caspian test range of the Azerbaijan Academy of Sciences, for the purpose of improving methods and equipment for research of the Earth's natural resources and study of the environment.

Photography and spectrometry of the Earth's surface from the "Salyut-7" station are being conducted simultaneously with photography from laboratory airplanes and helicopters, and measurements by ground observation posts. The objects of the studies are farmlands, forest vegetation, bodies of water, the layers of the atmosphere nearest the surface, and oil- and gas-bearing structures.

A biological experiment for studying the effects of zero gravity and of an artificial magnetic field on the spatial orientation of flax sprouts has been completed in the "Magnitogravistat" unit.

In the course of the day, the cosmonauts will perform another series of astrophysical studies using the "Mariya" instrument, and they will engage in physical exercise with the exercycle and the running track.

The flight of the orbiting complex "Salyut-7"--"Soyuz T-13"--Cosmos-1669" is proceeding normally. The condition of the health of Vladimir Dzhanibekov and Viktor Savinykh is good, and they are feeling well.

FTD/SNAP/9835
CSO: 1866/38

COMMENT ON 'GYUNESH-85' EXPERIMENT

Baku BAKINSKIY RABOCHIY in Russian 16 Aug 85 p 2

[Article by N. Barskiy, correspondent]

[Excerpt] Sheki, August 15. The scope of the aerospace experiment "Gyunesh-85" that has begun here ranges from peaks above the clouds to farmlands and large bodies of water in Azerbaijan. The crew of the orbiting station "Salyut-7" is taking part in this experiment together with associates of academy and industry scientific research institutions.

A unique "Space--Earth" link was in operation for only four minutes, during which photography and spectrometry of test areas were conducted from the spacecraft and airplanes, and on the Earth's surface. Associates of the Azerbaijan Academy of Sciences' Research and Production Association of Space Research worked quickly in syinchronization with the cosmonauts during this brief period of four minutes in which the orbiting complex was flying over our region. The association is providing the facilities for this major scientific experiment.

This year's studies, which began in the heat of August and will be completed in September, take in several zones of the republic and part of the Caspian Sea.

Commenting on this event, T. K. Ismailov, general director of the space research association, said: "'Gyunesh-85' is the continuation of satellite-aided research that was begun several years ago in Baku, and specifically of a major research program--the international aerospace experiment that was carried out last summer. Methods are being refined and equipment is being perfected in the interests of improving the effectiveness of the study of Earth from space. Our goal is to gather statistical data on physical phenomena on the Earth's surface, to develop methods for detecting, recognizing and observing objects of interest, and to determine optimal conditions for obtaining information."

FTD/SNAP/9835
CSO: 1866/38

COSMONAUTS CONTINUE RESOURCES AND ENVIRONMENT STUDIES

Moscow PRAVDA in Russian 17 Aug 85 p 1

[TASS Report]

[Text] Flight Control Center, August 16. Soviet cosmonauts Vladimir Dzhanibekov and Viktor Savinykh are continuing to carry out planned work on board the orbiting complex "Salyut-7"--"Soyuz T-13"--"Cosmos-1669". In the days just past, they completed an extensive program of geophysical studies in the interests of solving various scientific and economic problems.

The crew took part in the second stage of the large-scale experiment "Gyunesh-85", which aims at further improving methods and means of studying the Earth's natural resources and environment. In the course of the experiment they performed, specifically, spectrometry of oil- and gas-bearing regions of western Azerbaijan and the coastal zone of the Caspian Sea, photography of farmlands on the south slope of the Greater Caucasus, and measured optical characteristics of the atmosphere of the Caucasus-Caspian region.

In line with UNESCO's internationl program "Man and the Biosphere", the cosmonauts performed another series of observations and photography of biosphere preserves on the territory of the Soviet Union. These studies were aimed at solving an important contemporary problem--ecological forecasting, nature conservation, and rational land use.

Today the crew of the complex is conducting the experiment called "Kupol", which has the purpose of evaluating air pollution over large industrial centers with the aid of photographic, spectrometric and radiometric equipment. The experiment is being done in the area of the city of Zaporozhye.

In line with the program of astrophysical studies, the crew will study mechanisms of the generation of high-energy particles in near-Earth space during the day.

Cosmonauts Vladimir Dzhanibekov and Viktor Savinykh are in good health and are feeling well. The flight of the orbiting scientific research complex is proceeding normally.

FTD/SNAP/9835
CSO: 1866/38

TECHNICAL EXPERIMENTS, PHOTOGRAPHY ON 'SALYUT-7'

Moscow IZVESTIYA in Russian 17 Aug 85 p 3

[Article by A. Ivakhnov, correspondent]

[Abstract] The article is a report from the Flight Control Center on the variety of studies and experiments that cosmonauts Dzhanibekov and Savinykh on "Salyut-7" have recently become free to work on, following the long period of putting the station into working order, which included installing extra solar panels outside.

It is mentioned that the cosmonauts are tending the instrument called "Mariya" that has been set up inside the station. It registers X-ray noise from certain regions of the universe.

In line with an assignment from the State Committee for Science and Technology, the cosmonauts performed complex photography and spectrometry of the atmosphere over the city of Zaporozhye. The recordings lasted from when the city first appeared on the horizon in front of them until it disappeared behind them. The readings are expected to give a comprehensive picture of what substances exist in the air over the city and of their exact locations. The cosmonauts were also continuing observations of the atmosphere immediately surrounding the orbiting complex, to help determine the effects that engine exhausts, waste products ejected by the crew, and other factors may have on optical sensors and the solar panels.

It is mentioned that a technical experiment was performed in which systems of the "Cosmos-1669" ship which is docked with the station were used for orientation of the whole orbiting complex. Results reportedly showed that it is better to perform this type of operation with the station's systems.

Commentary also is given on the "Gyunesh-85" experiment for study of the Earth's resources. O. Maley, head of a laboratory of the Azerbaijan Academy of Sciences' Research and Production Association for Space Research of Natural Resources, explained that results of the first stage of the experiment, which was conducted last year ("Gyunesh-85") prompted many state farm directors to request space photographs of their pasture lands. The cosmonauts reportedly are also photographing forests, bodies of water, and regions with oil- and gas-bearing structures. Deputy mission director V. Blagov related that the crew has shot about 5,000 photo frames of sectors of the Earth's surface that are of interest.

It is also mentioned that the cosmonauts are tending plants in the station's greenhouse unit. Biologist G. Nechitaylo was advising them from the control center.

FTD/SNAP/9835
CSO: 1866/38

DEPUTY FLIGHT DIRECTOR BLAGOV COMMENTS ON WORK OF COSMONAUTS

Riga SOVETSKAYA LATVIYA in Russian 18 Aug 85 p 2

[Article by V. Ovcharov, special correspondent at the Flight Control Center]

[Excerpt] V. Dzhanibekov and V. Savinykh have been working in orbit for almost two and one-half months. After they installed extra panels on a solar battery of "Salyut-7" and increased the station's power resources, it became possible for them to begin studies of the Earth in earnest.

At a meeting with journalists, V. Blagov, deputy flight director and a USSR State Prize laureate, noted: "We already have some very nice scientific trophies. The crew has taken about 2,000 photographs of the planet's surface with the aid of the multizonal camera MKF-6M. Almost 600 frames have been shot with the topographic camera KATE-140. The cosmonauts have been working also with a spectrometer, the MKS-M; with hand-held cameras; and with a French instrument, the PCN, which is used in studying polar auroras and various atmospheric phenomena. Neither did they forget the 'Mariya'--an X-ray telescopye with which a series of astrophysical observations has been made. "

"New things have also been done. The crew has performed an experiment over the city of Zaporozhye for the first time, in line with an assignment from the USSR State Committee for Science and Technology. Many metallurgical plants are located in this city. The purpose of the experiment was to obtain a three-dimensional photograph of the atmospheric 'cap' over this large industrial center, using the MKF-6M."

FTD/SNAP/9835
CSO: 1866/38

'SALYUT-7' COSMONAUTS PASS TEN WEEK MARK IN ORBIT

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 21 Aug 85 p 1

[TASS Report]

[Text] Flight Control Center, August 20. The mission of Vladimir Dzhanibekov and Viktor Savinykh in near-Earth orbit has lasted now for two and one-half months.

Today's program of work by the crew of the scientific research complex includes technical and astrophysical experiments, observations of the Earth's surface, motion-picture and still photography, and physical exercise.

Of great interest to developers of space technology is information on the effects of open space on various materials, including photocells which are used as converters of solar energy into electric power. An experiment for evaluating the efficiency of the "Salyut-7" station's solar batteries is being performed today by the cosmonauts. They are evaluating not only batteries which have been functioning from the moment the station was placed into orbit, but also extra batteries which have been installed by crews. This experiment consists essentially in determining a number of the batteries' electrical parameters as the batteries are oriented in different ways toward the sun.

The program of technical experiments calls also for measuring characteristics of the atmosphere directly surrounding the orbiting complex, and perfecting instruments for future spacecraft.

Yesterday was day of medical examinations for Vladimir Dzhanibekov and Viktor Savinykh. A number of biochemical studies were made, an experiment was performed forthe purpose of selecting the optimal conditioning routines for physical exercise, and the condition of the cosmonauts' muscular systems was evaluated.

According to results of the examination, both cosmonauts are healthy.

The flight is proceeding normally.

FTD/SNAP/9835
CSO: 1866/38

COSMONAUT ACTIVITIES IN 11TH WEEK ABOARD 'SALYUT-7'

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 24 Aug 85 p 1

[TASS Report]

[Text] Flight Control Center, August 23. The 11th week of the mission of Vladimir Dzhanibekov and Viktor Savinykh on board the orbiting scientific station "Salyut-7" is ending.

The crew's program of work during the days just past included astrophysical and geophysical experiments, medical-biological studies, and routine inspections of individual systems of the station.

With the aid of the instrument "Mariya", another series of measurements of flows of high-energy electrons and positrons has been performed for the purpose of studying mechanisms of the generation of these particles in near-Earth space. In line with the plan of astrophysical experiments, the cosmonauts also have carried out studies of the interplanetary medium, zodiacal light, and radiation from weak galactic and extragalactic sources.

Observations, photography and spectrometry of the Earth's surface and measurements of optical characteristics of the atmosphere have been continued within the framework of the extensive program of geophysical research.

According to results of telemetry measurements and reports from orbit, the flight of the scientific research complex "Salyut-7"—"Soyuz T-13"—"Cosmos-1669" is proceeding normally. The condition of Vladimir Dzhanibekov's and Viktor Savinykh's health is good, and they are feeling well.

FTD/SNAP/9835
CSO: 1866/38

COSMONAUTS COMPLETE FINAL OPERATIONS WITH 'COSMOS-1669'

Moscow IZVESTIYA in Russian 28 Aug 85 p 1

[TASS Report]

[Text] Flight Control Center, August 27. Cosmonauts Vladimir Dzhanibekov and Viktor Savinykh have been in orbital flight for 83 days.

In the days just past, the crew has been engaged mainly in final operations with the satellite "Cosmos-1669", which, as has already been reported, is analogous to cargo ships of the "Progress" type in its design.

The cosmonauts installed delivered scientific apparatus and other cargo items in assigned places, and they pumped water into the station's tanks with the aid of the "Rodnik" system. The tanks of the first section of the combined engine unit have been refilled with fuel and oxidizer.

In line with the program for study of the Earth's natural resources and environment, the cosmonauts conducted several series of visual observations and photography of individual regions of land surface and the surface of the world's oceans.

Yesterday the first stage of a biological experiment called "Substrat" was performed on board the orbiting complex. Its purpose is to evaluate the effectiveness of various methods of cultivating higher plants in conditions of zero gravity.

Today the refueling of the station's tanks is continuing. These operations are being carried out on commands from the Flight Control Center, and they are being monitored by the crew.

The cosmonauts also will move used equipment into the emptied cargo compartment of "Cosmos-1669", and they will perform another cycle of measurements of parameters of the atmosphere directly surrounding the orbiting complex.

The flight is proceeding normally. Cosmonauts Vladimir Dzhanibekov and Viktor Savinykh are healthy, and they are feeling well.

FTD/SNAP/9835
CSO: 1866/38

'COSMOS-1669' UNDOCKS FROM 'SALYUT-7'

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 31 Aug 85 p 3

[TASS Report]

[Text] Flight Control Center, August 30. The flight of the artificial Earth satellite "Cosmos-1669", which was placed into near-Earth orbit on 19 July 1985, ended today.

The satellite was docked with the manned complex "Salyut-7"--"Soyuz T-13" on 21 July. The operations planned during the joint flight were carried out completely, including unloading, refueling of the station's combined engine unit, and pumping of drinking water into tanks of the station. A correction of the orbit of the scientific research complex was executed using the satellite's engine.

"Cosmos-1669" was separated from the station on 29 August at 0150 hours Moscow time. Tests of individual systems and units of the satellite continued while it was in independent flight. It was then moved into a descending trajectory, entered the dense layers of the atmosphere, and ceased to exist.

Today is another day of medical examinations for Vladimir Dzhanibekov and Viktor Savinykh, who are continuing work on board the orbiting station. Plans call for an examination of the cosmonauts' cardiovascular systems both at rest and under physical exertion, measurements of body temperatures and pulse rates, and a number of biochemical studies.

The cosmonauts are feeling well, and their morale is good. Both are healthy.

The work in near-Earth orbit is being carried out successfully.

FTD/SNAP/9835
CSO: 1866/38

COSMONAUTS COMPLETE THIRD MONTH IN ORBIT

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 7 Sep 85 p 1

[Tass Report]

[Text] Flight Control Center, 6 September. Soviet cosmonauts Vladimir Dzhanibekov and Viktor Savinykh have been working in near-Earth orbit for three months. In that time, they have successfully performed a complex of difficult repair and reconditioning operations on the "Salyut-7" station for the purpose of ensuring its further functioning in the manned mode, and they have done a large amount of scientific and technical research and experiments. The cosmonauts' high level of professional training and smooth teamwork have been in evidence throughout the prolonged orbital mission.

The program of work on board the manned complex "Salyut-7"—"Soyuz T-13" during the last two days included technological, technical and biological experiments, as well as visual observations of land surface and the waters of the world's oceans. Another medical examination of the crew was performed.

The first stage of an experiment called "Elektrotopograf" has been performed in line with the space materials-science program. The purposes of this experiment are to study the dynamics of change of the characteristics of various materials exposed to open space and to perfect methods for diagnosing the condition of these materials directly on board the orbiting station. In addition to specimens of model materials, a whole series of structural materials for future spacecraft are being studied in the experiment.

Biological experiments are continuing on board the orbiting complex. They are being conducted for the purpose of determining optimal conditions for cultivation of higher plants in spacecraft hothouses.

Today, Vladimir Dzhanibekov and Viktor Savinykh are doing technical-maintenance work on individual systems of the complex, and they are preparing scientific apparatus for upcoming work. The day's schedule also specifies time for physical exercise and for rest.

According to results of the medical examination that was performed the day before, both cosmonauts are healthy.

The flight of the scientific research complex "Salyut-7"—"Soyuz T-13" is proceeding normally.

FTD/SNAP/9835
CSO: 1866/38

EARTH OBSERVATION, MATERIALS STUDIES ON 'SALYUT-7'

Moscow IZVESTIYA in Russian 11 Sep 85 p 2

[TASS Report]

[Text] Flight Control Center, 10 September. Vladimir Dzhanibekov and Viktor Savinykh have been working in near-Earth orbit for 96 days.

In the days just past, the crew performed another cycle of geophysical studies. The crew made observations and photographs of individual regions of land surface and the waters of the world's oceans, and determined optical and spectral characteristics of the atmosphere. With the aid of the mass-spectrometry apparatus "Astra-1", a series of measurements was conducted for evaluating parameters of the atmosphere directly surrounding the orbiting complex.

Another experiment called "Elektrotopograf" was started in line with the space materials-science program.

Today the cosmonauts are conducting experiments for the study of mechanisms of the generation of high-energy particles in radiation belts of the Earth and of near-Earth space. Time also is set aside for physical exercise, to which a good deal of attention is devoted in the course of prolonged orbital flight.

According to telemetry measurements and the crew's reports, the flight of the scientific research complex "Salyut-7"--"Soyuz T-13" is proceeding normally.

Cosmonauts Vladimir Dzhanibekov and Viktor Savinykh are healthy, and they are feeling well.

FTD/SNAP/9835
CSO: 1866/38

COMMENTS ON COSMONAUTS' DIET, PROSPECTS FOR LONGER MISSIONS

Moscow SOVETSKAYA ROSSIYA in Russian 12 Sep 85 p 4

[Article by R. Kuznetsova]

[Abstract] The article comments on how cosmonauts Vladimir Dzhanibekov and Viktor Savinykh on board the orbiting station "Salyut-7" have kept good physical condition and morale after three months of hard work. Attention is devoted to the cosmonauts' diet and their physical-conditioning and leisure-time activities on the station, and the importance of these factors in promoting long-term working fitness. A recent conversation with cosmonaut Valeriy Kubasov is recalled in this connection, in which Kubasov expressed the belief that crews could remain in orbit for as long as a year without artificially created graviation. It is noted that the duration of the longest orbital mission in the history of space flight--237 days--is about the time it takes a spacecraft to reach the planet Mars, at the present-day level of technology.

Progress in providing the station's crew with a more varied diet is also noted. The menu of the present crew reportedly includes about 70 items. As compared with previous missions, in which crews had to stick to prescribed rations, they can now select dishes to their liking. The cosmonauts' diet calls for meals to be taken four times a day. Medical specialists think this routine ensures the most complete assimilation of food in the body.

FTD/SNAP/9835
CSO: 1866/38

COSMONAUTS COMPLETE 13TH WEEK IN ORBIT

Moscow IZVESTIYA in Russian 14 Sep 85 p 1

[TASS Report]

[Text] Flight Control Center, 13 September. The 13th week of the work of Vladimir Dzhanibekov and Viktor Savinykh on board the orbiting complex "Salyut-7"--"Soyuz T-13" is ending.

The crew's program for today calls for preparing scientific apparatus, inspecting individual systems of the station, observing the Earth's surface and photographing it with hand-held cameras, and engaging in physical exercise. The cosmonauts performed another cycle of astrophysical, technological and medical-biological experiments during the days just past.

A series of measurements of flows of high-energy electrons and positrons was made with the aid of the instrument "Mariya", for the purpose of studying mechanisms of the generation of these particles in near-Earth space.

For the purpose of studying the comprehensive effect of open-space factors on various structural materials, another "Elektrotopograf" experiment was performed in line with the space materials-science program. These experiments are being conducted in line with an expanded program which specialists developed, taking into account results of processing of specimens and electrotopograms that were obtained earlier.

In line with the medical monitoring plan, an examination of the cosmonauts' cardiovascular systems was made with the aid of the pneumatic vacuum suit "Chibis", in which a barometric-pressure differential is used to create a flow of blood to the lower part of the body and thereby simulate terrestrial gravity.

The condition of the health of Vladimir Dzhanibekov and Viktor Savinykh is good, and they are feeling well.

The onboard systems of the orbiting complex "Salyut-7"--"Soyuz T-13" are functioning normally.

FTD/SNAP/9835
CSO: 1866/38

TASS REPORTS LAUNCH OF 'SOYUZ T-14'

Moscow IZVESTIYA in Russian 18 Sep 85 p 1

[TASS Report]

[Text] In accord with the program of space research, a manned spaceship, "Soyuz T-14", was launched from the Soviet Union on 17 September 1985, at 0439, Moscow time. Its crew consists of Lieutenant Colonel Vladimir Vladimirovich Vasyutin, the ship's commander; pilot-cosmonaut of the USSR Georgiy Mikhaylovich Grechko, the flight engineer and a two-time Hero of the Soviet Union; and Lieutenant Colonel Aleksandr Aleksandrovich Volkov, cosmonaut-researcher.

The mission program calls for docking the "Soyuz T-14" ship with the orbiting complex "Salyut-7"--"Soyuz T-13". Cosmonauts Vasyutin, Grechko and Volkov are to carry out a complex of scientific-technical research and experiments on board the complex together with comrades Dzhanibekov and Savinykh, who have been working in near-Earth orbit since June 6, 1985.

The onboard systems of the "Soyuz T-14" ship are functioning normally. Comrades Vasyutin, Grechko and Volkov are feeling well.

The crew has begun carrying out the mission program.

FTD/SNAP/9835
CSO: 1866/38

BIOSKETCHES OF 'SOYUZ T-14' CREW

Moscow IZVESTIYA in Russian 18 Sep 85 p 1

[Text] Vladimir Vladimirovich Vasyutin was born March 8, 1952, in Khar'kov.

In 1969 he enrolled in the Kharkov Higher Military Aviation School for Pilots imeni Gritsevets. After graduating from the school, he served as a pilot-instructor in the Air Force. He mastered several types of airplanes in the course of his flight duty.

Vladimir Vladimirovich Vasyutin has been a member of the Communist Party of the Soviet Union since 1972.

V. V. Vasyutin was enrolled in the cosmonaut contingent in 1976.

In 1977 he graduated from a test-pilots' school. Vladimir Vladimirovich has the qualifications "Military pilot, 1st class" and "Test-pilot, 3rd class".

V. V. Vasyutin has passed the full course of training for flights on "Soyuz T" spaceships and "Salyut" orbiting stations.

* * *

Pilot-cosmonaut of the USSR Georgiy Mikhaylovich Grechko, a two-time Hero of the Soviet Union, was born May 25, 1931, in Leningrad.

After graduating from the Leningrad Mechanics Institute in 1955, he worked at a design bureau. He took part in the development and testing of space technology, proving himself to be a knowledgeable specialist with initiative. In 1984 he earned the academic degree of doctor of physical-mathematical sciences.

G. M. Grechko has been a member of the Communist Party of the Soviet Union since 1960.

He has been in the cosmonaut contingent since 1966.

G. M. Grechko has made two space flights: the first was in 1975, as flight engineer of the "Soyuz-17" ship and the "Salyut-4" station; the second was on the "Soyuz-26" ship and the "Salyut-6" station in 1977-78. He also trained for the Soviet-Indian mission as the flight engineer of the backup crew.

Georgiy Mikhaylovich does a great deal of public affairs work; he is deputy chairman of the Soviet Committee for the Defense of Peace.

* * *

Aleksandr Aleksandrovich Volkov was born May 27, 1948, in the city of Gorlovka, Donetsk Oblast.

After graduating from the Khar'kov Higher Military Aviation School for Pilots imeni Gritsevets in 1970, he served as a pilot-instructor in the Air Force. He mastered several types of airplanes. He has the qualifications "Military pilot, 1st class" and "Test-pilot, 2nd class".

A. A. Volkov has been a member of the Communist Party of the Soviet Union since 1973.

Aleksandr Aleksandrovich was enrolled in the cosmonaut contingent in 1976. He has passed the full course of training for space flights on "Soyuz T" ships and "Salyut" orbiting stations.

(Photographs of Vasyutin, Grechko and Volkov in their space suits are given.)

FTD/SNAP/9835
CSO: 1866/38

ADDITIONAL BACKGROUND DATA ON COSMONAUTS

Moscow TRUD in Russian 18 Sep 85 p 1

[Article by V. Golovachev, correspondent at the Flight Control Center]

[Abstract] The lengthy article gives information on the backgrounds and personalities of the crew members of the""Soyuz-T-14" spaceship.

Regarding the crew's commander, Vladimir Vasyutin, it is noted that he was in the backup crews of three missions before making the current flight, which is his first. In 1982, he was a member of the backup crew for the mission of the "Soyuz T-7" and he subsequently served in backup crews for the "Soyuz T-10" and "Soyuz T-12" missions. He reportedly began training for the current mission in September of 1984.

Regarding the flight engineer. Georgiy Grechko, it is recalled that he flew missions aboard the "Salyut-4" and "Salyut-6" orbiting stations, the latter flight setting a duration record of 96 days at the time. Going back further, it is recalled that he worked in Sergey Pavlovich Korolev's design bureau before he became a cosmonaut. At the same time he was training to become a cosmonaut, he prepared a candidate of sciences dissertation which involved the development of elements of the soft-landing system of the "Luna-9" and "Luna-13" spacecraft, which landed on the moon. Two years ago, Grechko submitted for defense a doctoral dissertation which was devoted to optical studies of the atmosphere and ionosphere and of astrophysical objects from "Salyut" orbiting stations.

The biography of the "Soyuz T-14" crew's cosmonaut-researcher, Aleksandr Volkov, is said to be similar in many details to that of commander Vasyutin. Like him, Volkov is a graduate of the Khar'kov Higher Military Aviation Schools for Pilots, and he was an instructor there. He was assigned to the cosmonaut training program in the same year as Vasyutin, and he also began training for the current mission last September.

The article also comments on the unprecendented deed of the "Soyuz T-13" crew of V. Dzhanibekov and V. Savinykh in restoring the "Salyut-7" station to working order after its power failure. It is mentioned that when they undertook their recovery mission in June of this year, "Salyut-7" had not been responding to signals from the control center since February.

FTD/SNAP/9835
CSO: 1866/38

'SOYUZ T-14' DOCKS WITH 'SALYUT-7' STATION

Moscow TRUD in Russian 19 Sep 85 p 1

[Text] On 18 September 1985, at 0615 hours Moscow time, the spaceship "Soyuz T-14" docked with the orbiting complex "Salyut-7"--"Soyuz T-13", which is piloted by Vladimir Dzhanibekov and Viktor Savinykh.

After checking the seal of the docking mechanism, Vladimir Vasyutin Georgiy Grechko and Aleksandr Volkov entered the station at 0924 hours. Five Soviet cosmonauts are working on board the scientific research complex "Salyut-7"--"Soyuz T-13"--"Soyuz T-14".

During the joint flight, which is scheduled for eight days, plans call for geophysical, astrophysical and medical studies and technical and biotechnology experiments to be carried out.

In line with the planned program, further work will be done on the station by Vladimir Vasyutin, Viktor Savinykh and Aleksandr Volkov, and Vladimir Dzhanibekov and Georgiy Grechko will return to Earth in the "Soyuz T-13" station.

According to telemetry data, the onboard systems of the "Salyut-7" station are functioning normally. Comrade-cosmonauts Dzhanibekov, Savinykh, Vasyutin, Grechko and Volkov are feeling well.

FTD/SNAP/9835
CSO: 1866/38

'SALYUT-7' DOCKING UNIT TESTED BY REDOCKING 'COSMOS-1669'

Moscow PRAVDA in Russian 19 Sep 85 p 6

[Article by A. Pokrovskiy, correspondent at the Flight Control Center]

[Abstract] The article is a report from the Flight Control Center describing the preparations for the docking of the "Soyuz T-14" spaceship with the orbiting complex "Salyut-7"--"Soyuz T-13". Comments of the crewmen aboard the "Soyuz T-14" and the "Salyut-7" station as they went about their work are recorded.

It is related that to confirm that the "Salyut-7" station's docking system was in good working order for receiving a spaceship with a visiting crew, a test of the system was performed during the time that the "Cosmos-1669" spaceship was a part of the orbiting complex. After cosmonauts Dzhanibekov and Savinykh had unloaded the "Cosmos-1669" ship, it was reportedly undocked from the station, backed off a certain distance, and then re-docked with the station, so that the crew could check out the functioning of the docking system.

FTD/SNAP/9835
CSO: 1866/38

5-MAN CREW BEGINS WORK ABOARD 'SALYUT-7'

Moscow MOSKOVSKAYA PRAVDA in Russian 20 Sep 85 p 1

[Text] Flight Control Center, 19 September. Cosmonauts Vladimir Dzhanibekov, Viktor Savinykh, Vladimir Vasyutin, Georgiy Grechko and Aleksandr Volkov are conducting joint work on board the orbiting complex.

In line with the program of biotechnology studies, the crew today began a series of experiments with a new electrophoresis unit that was delivered to the station in the "Soyuz T-14" spaceship. This automated unit is intended for perfecting the technology of obtaining, by the method of electrophoresis in conditions of weightlessness, superpure biological preparations for the needs of health care, the food industry and agriculture.

The cosmonauts performed a technical experiment called "Rezonans" for the purpose of determining dynamic characteristics of the orbiting complex and the magnitude of stresses affecting its structure.

As has been reported, Vladimir Dzhanibekov and Georgiy Grechko will return to Earth in the "Soyuz T-13" spaceship. For this purpose, the cosmonauts removed the chair which belongs to Viktor Savinykh from the landing module of the spaceship, and installed Georgiy Grechko's chair in its place. For the purpose of preparing for the return from orbit, Vladimir Dzhanibekov is undergoing conditioning with the aid of the "Chibis" pneumatic-vacuum suit, which simulates terrestrial gravity by variation of barometric pressure inside it.

In the course of the day, Vladimir Vasyutin and Aleksandr Volkov will conduct an experiment to study the possibilities of reflex-diagnostics for evaluating the condition of the body during the period of adaptation to weightlessness.

According to results of telemetry and the crew's reports, the flight of the manned complex is proceeding normally. All the cosmonauts are healthy and are feeling well.

FTD/SNAP/9835
CSO: 1866/38

ATMOSPHERIC STUDIES, BIOTECHNOLOGY EXPERIMENTS ON 'SALYUT-7'

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 21 Sep 85 p 1

[Text] The flight of cosmonauts Dzhanibekov, Savinykh, Vasyutin, Grechko and Volkov is continuing on board the orbiting complex "Salyut-7"--"Soyuz T-13"--"Soyuz T-14".

In line with the program of geophysical studies, the crew today is conducting experiments to study the structure of the Earth's atmosphere and to determine its optical and spectral characteristics. These studies are being carried out with scientific apparatus that was delivered in the "Soyuz T-14" ship in addition to apparatus that is on board the station.

In a unit called "Efu-robot", experiments are continuing to perfect technology for obtaining ultrapure biologically active substances by the method of electrophoresis in conditions of weightlessness.

The newly arrived crew on the station is carrying out a series of medical studies. Results of an experiment called "Optokinez" will help in assessing causes of vestibular disorders during the acute period of adaptation to weightlessness. The purpose of an experiment called "Signal-RD", which is being done today, is to study the possiblity of using the method of reflex-diagnostics on manned flights.

Today's schedule calls also for a televised report, during which the cosmonauts will tell about their work together on board the orbiting scientific research complex.

The flight is proceeding normally. The heal

The health of Vladimir Dzhanibekov, Viktor Savinykh, Vladimir Vasyutin, Georgiy Grechko and Aleksandr Volkov is good, and they are feeling well.

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TASS REPORTS THIRD DAY OF WORK BY JOINT CREW

Moscow PRAVDA in Russian 22 Sep 85 p 1

[TASS Report]

[Text] Flight Control Center, 21 September. Five Soviet cosmonauts are in their third day of work on board the orbiting scientific station "Salyut-7".

Today's schedule calls for astrophysical, biotechnology and technical experiments, motion-picture photography of the crew's work together, and a televised report.

The purpose of an experiment called "Ekstinktsiya", which is being done in line with the program of geophysical research, is to determine the density of aerosol layers of cosmic origin in the Earth's atmosphere. The experiment is being conducted using the electron photometer EFO-1, and it involves measuring the brightness of stars as they set beyond the Earth's horizon.

In line with the program of biological research, an experiment has been done in the "Svetoblok-T" unit to form a synthetic gel which can be used for electrophoretic purification of substances on Earth.

During the day the cosmonauts will work on perfecting methods of orienting spacecraft using standard apparatus and experimental optical instruments, and they will perform another cycle of biotechnology experiments in the "EFU-robot" unit.

According to medical monitoring data and radio conversations with the crew, the health of Vladimir Dzhanibekov, Viktor Savinykh, Vladimir Vasyutin, Georgiy Grechko and Aleksandr Volkov is good, and they are feeling well.

The program of work in near-Earth orbit is being carried out successfully.

FTD/SNAP/9835
CSO: 1866/38

COSMONAUTS TAKE PART IN 'BLACK SEA-85' EXPERIMENT

Moscow GUDOK in Russian 24 Sep 85 p 1

[TASS Report]

[Text] Flight Control Center, 22 September. Soviet cosmonauts Vladimir Dzhanibekov, Viktor Savinykh, Vladimir Vasyutin, Georgiy Grechko and Aleksandr Volkov are continuing joint research.

The working day on board the orbiting complex began today at 0900 hours Moscow time. After breakfast and a check of individual systems of the station, the cosmonauts worked on preparing scientific apparatus for operation.

Vladimir Vasyutin underwent a medical examination, the results of which are being used to determine the degree of his adaptation to conditions of space flight. The examination, which consisted of determining the reaction of the cardiovascular system to a measured amount of physical exertion, was conducted with the aid of the stationary bicycle and the recording apparatus "Aelita" and "Reograf".

Another cycle of research for the further study of the structure of the Earth's atmosphere has been carried out.

Today the cosmonauts are taking part in the large-scale experiment "Black-Sea-85", which is being conducted in line with the "Intercosmos" program of international cooperation in the field of study and use of outer space for peaceful purposes. This experiment, which was prepared by specialists of the People's Republic of Bulgaria, the German Democratic Republic, the Polish People's Republic and the Soviet Union, is being carried out for the purpose of perfecting methods of determining hydrophysical and biological characterist of the water surface.

Photography and spectrometry of separate regions of the Black Sea will be conducted simultaneously from the "Salyut-7" station, specialized artificial Earth satellites, laboratory airplanes, and from scientific research ships.

According to telemetry data and reports from orbit, the flight of the scientific research complex "Salyut-7"--"Soyuz T-13"--"Soyuz T-14" is proceeding normally.

All the cosmonauts are healthy and are feeling well.

FTD/SNAP/9835
CSO: 1866/38

COSMONAUTS CONTINUE GEOPHYSICAL, BIOLOGICAL RESEARCH

Moscow IZVESTIYA in Russian 24 Sep 85 p 1

[Text] Flight Control Center, 23 September. The flight of five Soviet cosmonauts together on board the orbiting complex "Salyut-7"--"Soyuz T-13"--"Soyuz T-14" is continuing.

Today the crew's program of work includes biotechnology experiments and geophysical and medical studies.

In the "EFU-robot" unit, another cycle of experiments has begun for perfecting processes of obtaining ultrapure biologically active substances in conditions of weightlessness.

In line with the program of geophysical studies, the crew today is conducting another series of experiments to study the structure of Earth's atmosphere and to determine its spectral and optical characteristics, they are making observations of individual regions of land surface and the oceans and are photographing them using hand-held cameras.

The condition of the organism of cosmonauts during the period of adaptation to weightlessness is of great interest to specialists in the medical support of missions. For this purpose, Aleksandr Volkov will carry out the experiment called "Optokinez", and Georgiy Grechko will have an electrocardiogram recorded in the course of the day.

The day's schedule calls for a televised report from the orbiting complex, during which the cosmonauts will tell about their joint work.

According to reports from orbit and results of telemetry, the flight is proceeding normally.

Cosmonauts Vladimir Dzhanibekov, Viktor Savinykh, Vladimir Vasyutin, Georgiy Grechko and Aleksandr Volkov are healthy and are feeling well.

FTD/SNAP/9835
CSO: 1866/38

COMMENTARY ON EFU-ROBOT ELECTROPHORESIS UNIT

Moscow PRAVDA in Russian 24 Sep 85 p 6

[Article by A. Tarasov, correspondent at the Flight Control Center]

[Abstract] The article reports on experiments being conducted in the automated electrophoresis unit "EFU-Robot" on board the orbiting station "Salyut-7". The unit was developed by the USSR Academy of Sciences' Institute of Bioorganic Chemistry imeni Shemyakin, which is identified as the methodology leader of the present biotechnology program.

Comments of O. Mitichkin, senior engineer of the Institute of Medical-Biological Problems, regarding the operation of the "EFU-Robot" are recorded. It has a storage chamber where solutions are kept. The operator removes the needed ampoules with solutions and places them into the unit's working chamber. He then plugs the unit into the power system and selects the needed program on a dial. After the exposure time is ended, the operator switches on a program for taking purified fractions. Syringes automatically fill 16 ampoules in a drum with the finished substances from the electrophoresis chamber. It is reported that more than 30 ampoules were being prepared fro return to Earth at the time of the report. Mitichkin related that the first two days oi experiments were devoted to purifying a valuable anti-influenza preparation made from the shell of influenza virus. On Earth it will serve as a reference standard for the making of vaccines and serums.

FTD/SNAP/9835
CSO: 1866/38

TASS REPORTS PREPARATIONS FOR RETURN OF 'SOYUZ T-13' SHIP

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 25 Sep 85 p 1

[TASS Report]

[Text] Flight Control Center, 24 September. The flight of Vladimir Dzhanibekov and Georgiy Grechko as members of the crew of the orbiting complex is nearing completion. Their program of joint work on board the "Salyut-7" station has been carried out in its entirety, and the cosmonauts are preparing the spaceship "Soyuz T-13" for the return to Earth.

Materials from studies that have been carried out are being stowed by the cosmonauts in the spaceship's reentry vehicle, and used equipment is being stowed in its living module. Exposed motion-picture and photographic films, specimens of structural materials that have been exposed in open space, ampoules containing substances obtained in the course of biotechnology experiments, and flight documents will be delivered to Earth.

The crew also will check the functioning of onboard systems of the spaceship and conduct a test firing of its engine.

All work on board the orbiting complex "Salyut-7"--"Soyuz T-13"--"Soyuz T-14" is being performed in strict accordance with the planned schedule.

Cosmonauts Vladimir Dzhanibekov, Viktor Savinykh, Vladimir Vasyutin, Georgiy Grechko and Aleksandr Volkov are healthy and are feeling well.

FTD/SNAP/9835
CSO: 1866/38

TASS REPORTS UNDOCKING OF 'SOYUZ T-13'

Moscow IZVESTIYA in Russian 26 Sep 85 p 1

[TASS Report]

[Text] Flight Control Center, 25 September. The flight of five Soviet cosmonauts together on board the orbiting scientific research complex has come to an end. Today at 0758 hours Moscow time, the "Soyuz T-13" ship, which is being piloted by Vladimir Dzhanibekov and Georgiy Grechko, was separated from the "Salyut-7" station. A crew consisting of commander Vladimir Vasyutin, flight engineer Viktor Savinykh and cosmonaut-researcher Aleksandr Volkov is continuing to work on board the station.

According to the mission program, the return of Vladimir Dzhanibekov and Georgiy Grechko to Earth is planned for September 26.

In the course of independent flight, the crew of the "Soyuz T-13" ship will test methods of rendezvousing spacecraft.

According to reports from orbit and the results of telemetry, the flight of the scientific research complex "Salyut-7"--"Soyuz T-14" and of the transport ship "Soyuz T-13" is proceeding normally.

The cosmonauts are in good health and are continuing to carry out their scheduled work.

FTD/SNAP/9835
CSO: 1866/38

'SOYUZ T-13' LANDS WITH COSMONAUTS DZHANIBEKOV AND GRECHKO

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 27 Sep 85 p 1

[TASS Report]

[Text] Another stage of the work on board the orbiting scientific station "Salyut-7" has been completed.

On 26 September 1985, at 1352 hours Moscow time, Vladimir Dzhanibekov and Georgiy Grechko returned to Earth in the "Soyuz T-13" spaceship after completing the planned program of joint research and experiments. Vladimir Vasyutin, Viktor Savinykh and Aleksandr Volkov are continuing to work on board the manned complex "Salyut-7"--"Soyuz T-14".

The reentry module of the "Soyuz T-13" ship made a landing in the designated region of the territory of the Soviet Union, 220 kilometers northeast of the city of Dzhezkazgan. The cosmonauts were feeling well after the landing.

Delivered to Earth were materials of research and experiments performed by Vladimir Dzhanibekov and Viktor Savinykh during the prolonged flight, and also by the crew of five cosmonauts during their joint work. The information that was obtained will find use in the interests of the advancement of science and of various branches of the economy.

The fourth long-term expedition on "Salyut-7" began 8 June 1985, following the successful docking of the "Soyuz T-13" ship with the station. In the course of their flight, Vladimir Dzhanibekov and Viktor Savinykh restored the station to working order, demonstrating courage and high professional skill in doing this.

The cosmonauts carried out an extensive program of scientific-technical research, and made an egress into open space to install extra solar panels.

For the first time, a crew has been partially replaced, which ensures the continuous operation of the manned space complex over an extended time, and substantially heightens the effectiveness of its use in the interests of science and the economy.

FTD/SNAP/9835
CSO: 1866/38

COSMONAUTS PRACTICED RENDEZVOUS BEFORE DESCENT OF 'SOYUZ T-13'

Moscow TRUD in Russian 27 Sep 85 p 3

[Article by V. Golovachev, correspondent at the Flight Control Center]

[Abstract] The article consists of commentary on the return to Earth of cosmonauts Vladimir Dzhanibekov and Georgiy Grechko in the "Soyuz T-13" spaceship. In addition to some details on the undocking, reentry and landing, the article reports on flight maneuvers that were practiced before reentry.

After undocking and drifting away several dozen meters from the "Salyut-7" station, the cosmonauts fired an engine which increased the distance between their ship and the station to several tens of kilometers, according to the account. At that time an experiment was begun. It called for rendezvousing with the station without any reciprocal signals from the station. The experiment is said to have simulated the situation that Dzhanibekov and Viktor Savinykh had to tackle in June when they rendezvoused and docked with the disabled station. On instructions from the Control Center, the cosmonauts reportedly fired the "Soyuz T-13" ship's engine three times. This three-pulse maneuver brought the ship to within 5 kilometers of the station. At this point, Dzhanibekov and Grechko took over manual control of the ship and began to guide it toward the station, which had all its navigational apparatus shut down by its crew. Being careful with how much fuel they used, the "Soyuz T-13" crewmen reportedly guided the ship to within several hundred meters of the station, from which distance it is said that there is no particular difficulty in linking up. The experiment reportedly was of value for the refining of maneuvers that could be necessary for coming to the aid of disabled spacecraft.

Regarding the landing of "Soyuz T-13", the article notes that the landing site 220 kilometers northeast of Dzhezkazgan was a new one for spacecraft landings. It has level ground, and during the landing there was little cloudiness, slight winds, and the temperature was higher than 23 degrees Celsius. The reentry vehicle's braking engine burned for 201 seconds, after which it went into a descending trajectory, and the braking parachute opened at an altitude of 9,500 meters.

FTD/SNAP/9835
CSO: 1866/38

'COSMOS-1686' LAUNCHED TO DOCK WITH 'SALYUT-7'

Moscow PRAVDA in Russian 28 Sep 85 p 2

[TASS Report]

[Text] In accord with the program of research of outer space, an artificial Earth satellite, "Cosmos-1686", was launched from the Soviet Union on 27 September 1985.

The purpose of the flight is to perfect equipment, aggregates and elements of the structure of the satellite in various flight modes, including joint flight with the "Salyut-7" station.

The satellite "Cosmos-1686" is similar in design to the artificial Earth satellites "Cosmos-1267" and "Cosmos-1-43", which were tested during the period 1981-1983 in various modes and in the course of joint flight with the orbiting stations "Salyut-6" and "Salyut-7".

The satellite's orbit parameters are: maximum distance from the surface of the Earth--320 kilometers, minimum distance from the surface of the Earth--178 kilometers; period of revolution--89.2 minutes; orbit inclination--51.6 degrees.

According to telemetry data, the onboard systems of the "Cosmos-1686" satellite are functioning normally.

FTD/SNAP/9835
CSO: 1866/38

COMMENTARY ON 237-DAY EXPEDITION TO SALYUT-7

Moscow ZEMLYA I VSELENNAYA in Russian No 2, Mar-Apr 85 pp 9-15

[Article by S. A. Bovin: "'Salyut-7': Third Expedition to the Station"]

[Text] The 237-day flight of Soviet cosmonauts aboard the Salyut-7 station, the longest in the history of the space age, has been completed (Zemlya i Vselennaya, 1983, No 1, p. 2; 1984, No 1, p. 6; No 3, p. 2; No 6, p. 2 - Ed.). The crew in flight performed a large volume of medical, biological, technological, astrophysical, geophysical as well as preventive intenance work.

The flight to the Salyut-7 station began on 8 February 1984 aboard the Soyuz T-10 transporter. The goal of the flight was to discover how successfully a group of three persons could tackle scientific-technical problems in lengthy orbital flight. For successful management of this experiment and the corresponding medical examinations directly on board the station, cardiologist O. Yu. At'kov was included in the crew. Besides the standard medical apparatus, a special apparatus was also delivered to the station for better observation of the condition of the cosmonauts during the lengthy flight. The presence of a doctor on board the station provided an objective assessment of the state of the crew and, if necessary, the lengthy flight could be curtailed.

The Doctor During a Lengthy Space Flight

To solve the problem of creating a permanent orbital station a large number of purely medical questions must be answered.

Despite the sizable volume of medical information gathered during lengthy voyages aboard the Salyut-6 and Salyut-7 stations, a full understanding of the nature, mechanisms and dynamics of development of the changes occurring in the human organism during lengthy space flight requires complicated procedures requiring special medical knowledge and skill to be conducted during the flight. For this reason the qualified cardiologist and candidate of medical sciences O. Yu. At'kov, was included in the crew. The choice of a cardiologist was dictated by the fact that the cardiovascular system is the most sensitive to the effects of weightlessness.

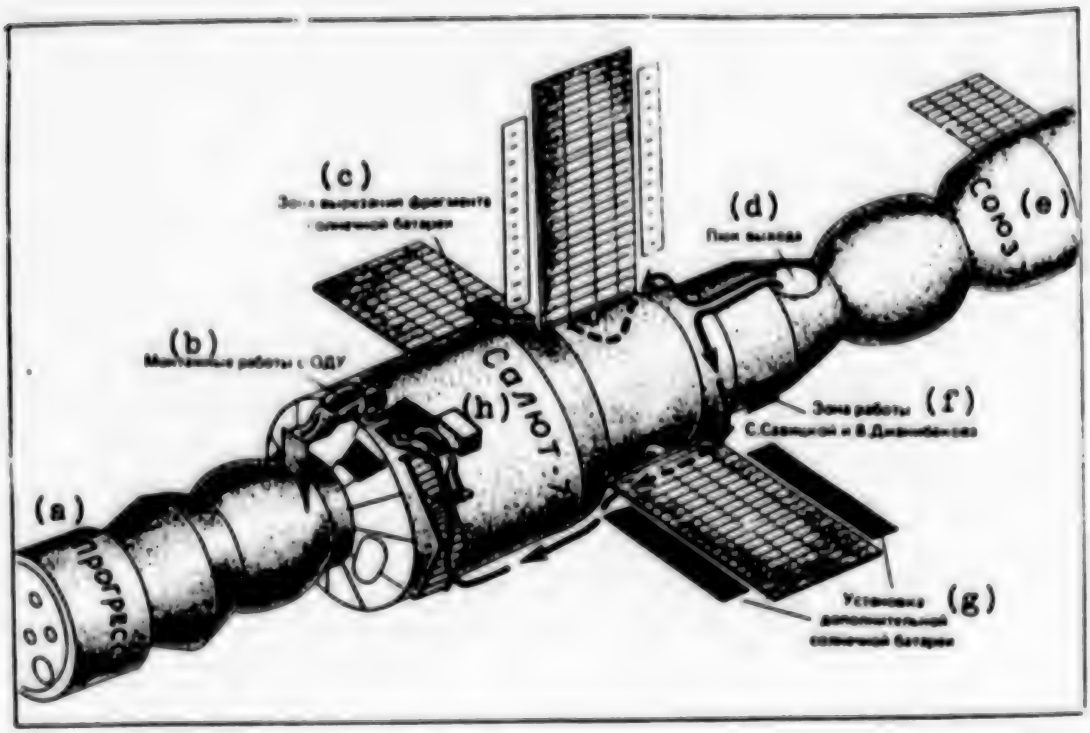
O. Yu. At'kov, a specialist in the field of functional diagnostics, is very adept at the methods of examining the circulatory system, including the highly-informative modern methods of ultrasonic probing of the heart, vessels and internal organs. It is no surprise that his work program devoted considerable space to just such research methods, carried out by means of the Argument and Ekhograf equipment. At the same time, he made broad use of the methods of investigating the electric and mechanical activity of the heart by means of the Aelita apparatus.

It should be mentioned that the presence of a cardiologist on board permitted a broader volume of findings as to the condition of the cardiovascular system thanks to the use of new kinds of functional tests that would not be possible without a specialist, as well as an increased volume of recorded and interpreted information. In fact, the medical information previously transmitted through the telemetry channels was mainly for monitoring purposes, whereas the data of primarily scientific interest was recorded on magnetic film and interpreted only after arrival on earth. The presence of a qualified specialist permitted an interpretation of the cardiological data immediately after the experiments, with the appropriate procedural corrections if necessary.

It must not be thought that the scientific investigations of At'kov were purely cardiological in nature. On the contrary, a large bulk of his program involved studies of the metabolic processes, not previously done, since they require the taking of venous blood and working with complicated equipment. He was also involved in the study of the functions of the vestibular and visual analyzer systems. The program allotted much attention to general clinical investigations: examination, auscultation, evaluation of the neurological condition and so forth. At'kov devoted much attention to anti-infection measures--the condition of the body's defensive forces, the level of purity of the atmosphere and interior surfaces of the pressurized compartments of the station.

Thus, as concerns the purely medical aspects, the presence of a doctor significantly expanded the volume of scientific information. An important place in the scientific work of At'kov on board the station was occupied by psychological investigations. The work was largely informal (filling in questionnaires and the like), but was done simultaneously with the systematic observation of the mood, working fitness and interpersonal relationships in connection with such factors as stress and work intensity and the organization of the work and rest regime.

Finally, we should point out that At'kov conducted two very important experiments involving fundamental aspects of biology. In the Membrana experiment on red blood cells and artificially-created analogs of biological membranes, interesting results were obtained revealing the features of the functions and vital cell components responsible for communication with the environment. In the experiment Genom, an attempt was made to employ the advantages conferred by weightlessness to separate large fragments of the DNA molecule, enabling a faster deciphering of the human genetic code.



On the surface of the Salyut-7 station there were several zones were the cosmonauts conducted assembly work during the third voyage. The paths traveled by the cosmonauts on the surface of the station in open space are indicated.
Key:

a. Progress
b. Assembly work with the ODU [main engine]
c. Solar battery cutout zone
d. Exit hatch
e. Soyuz
f. Work zone of Savitskaya and Dzhanibekov
g. Installation of auxiliary solar battery
h. Salyut-7

The First Indian Cosmonaut in Space

On 3 April 1984 in accordance with the flight program an international expedition visited the Salyut-7 station. Its crew was Yu. V. Malyshev, commander of the Soyuz T-11; G. M. Strekalov, flight engineer; and R. Sharma, scientist-cosmonaut and citizen of the Republic of India. The meeting of the two crews on board the station was joyous. Usually the visiting expeditions are short, while the scheduled work volume is very large. Therefore both guests and hosts must work with complete dedication to cope with the strict schedule.

The cooperation of the USSR and India in the study and development of outer space embraces a wide sphere of activity (Zemlya i Vselennaya, 1984, No 5, p. 44 - Ed.). The work performed on board the station is only a portion of the joint research plan. Several of the experiments carried out by the crew of the visiting expedition from 3 through 11 April 1984 are the following.

Ballisto investigates the force of the heart contractions and the coordination of the working of the right and left sections of the heart.

Vektor studies the bioelectrical activity of the heart, the phase structure of the cycle and the blood circulation volume.

Yoga studies the possibilities and effectiveness of using yoga exercises to prevent adverse effects of weightlessness on the human skeletal and muscular system.

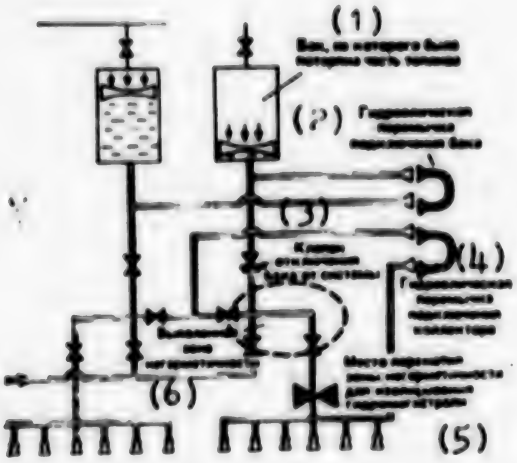
Terra is a photographic survey of the territory of India by means of multizonal camera. These investigations are aimed at studying the natural resources of India and the adjacent waters of the Indian Ocean. The obtained information will be used to solve the fuel-power and agricultural problems of the Indian economy, and also for geological, glaciological and hydraulic engineering research.

Pereokhlazhdeniye is a technological experiment conducted to explain the role of heterogeneous growth centers present on the surface of a melt; determination of the degree of supercooling; the influence of convection caused by gravity and temperature gradients on the supercooling; the possibility of formation of metastable phases and of producing massive amorphous materials. The experiment was done with a silver-germanium alloy, proposed by the Indian specialists.

New Types of Assembly Work in Space

On 9 September 1983 the systems monitoring service of the Salyut-7 station detected a change in pressure in one of the tanks of the engine unit. Subsequent analysis revealed that, owing to a loss of pressure in the hydraulic portion of the system, a partial fuel loss had occurred. This alarmed the designers and developers of the electrical circuitry, as fuel is a corrosive component in the engine system and its contact with the structure or cables may lead to their destruction which, in turn, could affect the controllability of the station. However, control studies on earth and test inspections at the station revealed that the serviceability of the station was not impaired.

Now a difficult problem was confronted: to find the location of the pressure loss. After further check-outs of the system, the zone where the defect should lie was determined, which allowed the designers to start developing a procedure and special tools for working in open space.



Section of the diagram of the engine unit of the station where pressure leak was detected.
Key:

1. Tank where partial fuel loss occurred
2. Hydraulic connector for tank
3. Valve disconnecting tank from system
4. Hydraulic connector for collector
5. Location of clamping of pressure loss zone to isolate hydraulic main
6. Discovered pressure loss zone

After the fabrication of the tool and its delivery to the station, L. D. Kizim and V. A. Solov'yev performed the necessary work during four consecutive space-walks (23, 26, 29 April and 4 May 1984). The cosmonauts were able to install two hydraulic connectors on the technological outlets of the engine unit.

In early May the specialists arrived at a conclusion: in order to complete the work it was necessary to build additional equipment and tools and deliver them to the station. Therefore the work was temporarily halted.

On 8 August 1984 V. A. Solov'yev and L. D. Kizim completed their last space-walk. Again they moved to the rear of the station and, finding the required pipeline in the maze of hydraulic mains, clamped it with a special device.

Welding in Outer Space

On 17 July 1984 the next visiting expedition in Soyuz T-12, consisting of V. A. Dzhanibekov (commander), S. Ye. Savitskaya (flight engineer) and I. P. Volk (scientist-cosmonaut) were sent to the Salyut-7 station as "guests" of Kizim, Solov'yev and At'kov. This was an interesting crew, especially since Dzhanibekov was making his fourth space flight, while Savitskaya was the first woman to be in orbit twice. But the most remarkable fact about this

crew was their unusual mission--to carry out an experimental machining of metal specimens in open space.

Savitskaya began to perform the work. She was assisted at the outside of the station by Dzhanibekov, while Volk inside the station supervised the time chart of the operations, using the internal radio link.

The unusual and complicated nature of this work required a lengthy preparation. Even on earth, metalworking (welding, cutting, soldering, coating) is not easy. But in space, with its unavoidable concomitant of weightlessness... Under these conditions a molten metal behaves differently than on earth. A universal manual tool was developed at the Paton Institute of Electric Welding of the Ukrainian SSR Academy of Sciences for the planned work. Dzhanibekov assisted Savitskaya in mounting the apparatus on the surface of the station and the experiment began. Savitskaya carried out a program of work with titanium, steel and aluminum specimens. Dzhanibekov carried out a work program on welding, soldering, and coating.

The specimens were returned to earth and preliminary laboratory investigations already give reason to state that metalworking is possible in open space.

The Investigations Continue

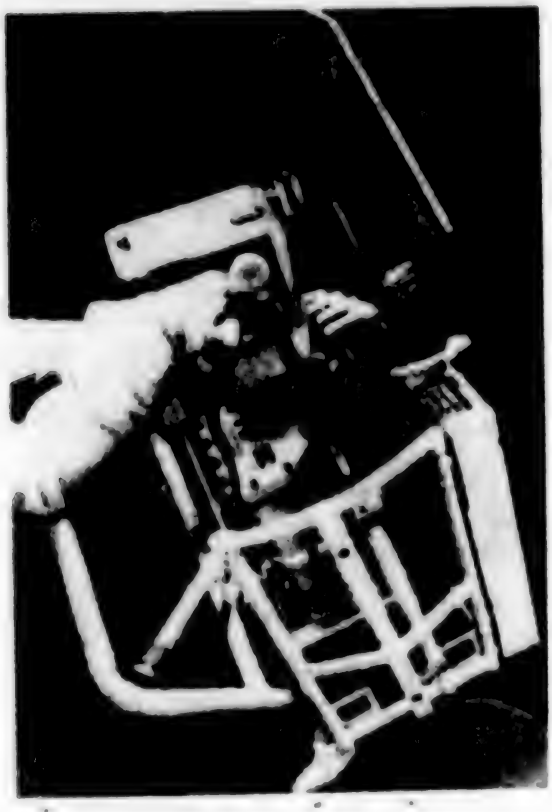
The crew of the third expedition continued the investigations of the earth's resources. These were done in three stages. At the first stage (February-April) the identical regions of the earth's surface were surveyed with the sun in different positions. At the second stage (May-July) a survey was made of the most interesting regions upon requests of scientists. At the third stage (August-September) complex surveys were conducted in the international programs Chernoye More and Gyunesh-84..

Upon instruction of petrochemists, the experiment Tamponazh was conducted, devoted to investigation of the mechanism of channel formation in suspensions used to plug oil wells.

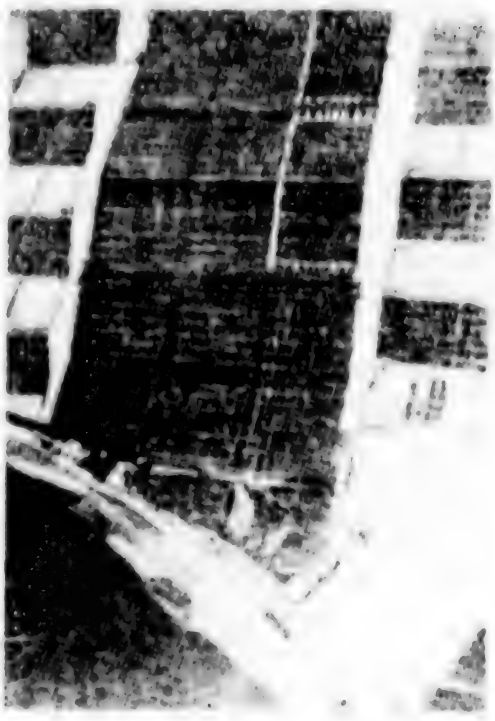
In the field of industrial technology the cosmonauts set up experiments with the Izparitel'-M and Pion-M devices. The first is designed for automatic application of coatings of silver and copper alloy to titanium substrates, while the second conducted experiments to investigate heat transfer processes on model substances in conditions of weightlessness.

Experiments involving the study of the kinetics of degradation of dielectric materials (photoresists, plastics) in a vacuum were carried out with the Elektrotopograf equipment.

A promising trend in the investigations conducted on board the station is the optimization of a technology of production of superpure medical-biological preparations with the Tavriya electrophoresis equipment, aimed at producing an antiviral drug.

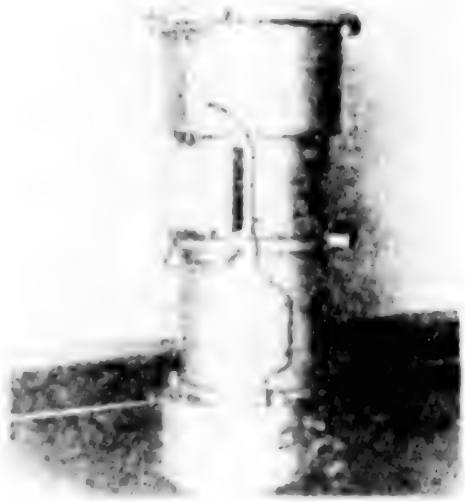


Installation for metalworking in outer space developed by the Paton Electric Welding Institute of the Ukrainian SSR AS.



Solar battery, to the right and left of which L. D. Kizim and V. A. Solov'yev mounted two additional panels.

The Soviet RS-17B x-ray spectrometer.



The French GSPS x-ray telescope.

The environment around the station was monitored by means of the Astra apparatus.

The Rezonans experiment provided information as to the accelerations occurring in the station under various influences on its structure, e.g., physical exercise performed by the crew with the on-board athletic equipment in resonance conditions. These studies will clarify the level of allowable dynamic load on the structure of the station.

Electrical Power Supply of the Station

The increased number of scientific apparatus delivered to the station by the Progress craft requires an ever larger quantity of electricity. This problem is being solved by enlarging the active area of the solar batteries by installing additional panels. The crew of the preceding expedition already performed such an unusual operation on the station by increasing the area of one of the three solar batteries. Exactly the same work, but now to enlarge a second solar battery, was done by L. D. Kizim and V. A. Solv'yev. Exploiting the experience of the preceding crew, they required not two, but only one spacewalk to install the auxiliary solar battery.

Another problem in the power supply system of the station is increasing the resistance of the structure of the solar batteries and their components to the destructive effects of outer space. In order to understand how to protect and from what effects, it was necessary to "inspect" the solar batteries themselves. Therefore in one of six spacewalks Solov'yev and Kizim cut out a small section (200 X 200 mm) from the operating panel of the solar battery, which was returned to earth.

Astrophysical Experiments

An interesting field of research in astrophysics is the x-ray map of the stars, where the capabilities of cosmonautics and the needs of astrophysicists are very fortunately combined.

In order to investigate sources of x-ray emission, the Siren' instrument complex was delivered to the Salyut-7 station. This enabled spectrometric investigations of x-ray sources in the energy range of 2-600 keV with high time and energy resolution.

The instrument complex included the French GSPS (gas scintillation proportional spectrometer) x-ray telescope and the Soviet RS-17B x-ray spectrometer.

The receiving equipment of the Siren' complex is to be situated outside the station. The structure of the station did not enable the cosmonauts direct exit into space: for this, they used one of the compartments of the station--an intermediate chamber. The GSPS and RS-17B instruments were installed in the intermediate chamber by the crew and joined by cables across hermetic electrical outlets to the control and recording instruments located in the working compartment of the station.

After the separation of the last Progress-23 cargo ship, the intermediate chamber was depressurized, and then the crew opened the hatch with the rear docking unit from the working compartment. Hereafter the quality of the work depended on the skill of the station crew, who aimed the receiving apparatus of the Siren' x-ray complex at the points of investigation with the precision of a jeweler and recorded the signals on magnetic film. In all, there were 46 observation sessions during three weeks of work and 11 magnetic-film cartridges were obtained, registering the results of observation of the sources Taurus X-1, Cygnus X-1, Cygnus X-2, Cygnus X-3, the center of the galaxy and the periodically-flaring source AO535+26.

Thus, the longest space voyage was completed. For its support, around 11 tons of cargo were dispatched from earth. All the scheduled work was completed, the psychological climate aboard the station was healthy, and the contact between the crew and the flight control center was excellent.

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INTERVIEW WITH COSMONAUTS KIZIM AND SOLOV'YEV

Moscow ZEMLYA I VSELENNAYA in Russian No 2, Mar-Apr 85 pp 16-22

[Text] We have passed another milestone in the exploration and development of outer space. For 237 days, crew commander L. D. Kizim, flight engineer V. A. Solov'yev and scientist-cosmonaut-physician O. Yu. At'kov conducted an uneasy watch in space aboard the orbiting station Salyut-7. More than 500 experiments were performed, and a large volume of medical research.

Our correspondent G. I. Vorob'yev asked cosmonauts L. D. Kizim and V. A. Solov'yev to describe the flight and the work performed over nearly eight months.

[Question] Your record flight consisted of individual hours and days of intense effort. One might think that these were not monotonous. Obviously each day furnished something new.

[Answer] Of course! But to a certain extent it was a well-planned novelty. After all, such a lengthy and voluminous program was preceded by a long and varied training, both professional and psychological. The experience of previous lengthy flights was consulted and new means and methods were developed to assure our life support and working fitness in the upcoming flight. All this instilled confidence and optimism. But the barrier of the unknown was still present.

We understood that the success of the expedition largely depended on our proper teamwork during the flight. Today we may mention with satisfaction that perfect teamwork, common interest in the success of the mission and friendly cooperation reigned in our crew during all 237 days.

[Question] Each of your working days was obviously loaded to the limit. What was the working procedure on board the station?

[Answer] It is impossible to list all the experiments and investigations conducted during the flight. But all of them required observation of mandatory conditions, a strictly-defined attitude of the station, a monitoring of time intervals and so forth.

The research program was based on the "block" principle, where the work in each field proceeds rather long, such as one or two weeks. This allows a concentration on the experiment, analysis of the findings and introduction of the necessary corrections.

Thus, geological experiments were conducted when we discovered and recorded various structures and formations promising for mineral prospecting, we studied the behavior of the ocean, its biological resources, the influence on the weather, we conducted technological experiments with the Isparitel', Tamponazh, Tavriya and Elektrotopograf equipment and astrophysical experiments, recording x-ray sources in the universe by means of special equipment.

[Question] You devoted much time to photographing the earth's surface and visual observations according to an earth resource and ocean study program.

[Answer] Yes. The Crimea and the Black Sea, the Caspian Depression, regions adjoining the Baykal-Amur railroad, the Central Asian republics, Western Siberia, the Primorskiy kray, Pamir and Tyan-Shan--all this was the object of our study. We carried out the requests of several hundred Soviet organizations and a number of socialist nations using space information in their scientific and industrial activity.

[Question] Incidentally, the realization of a long research program requires replenishing of the resources of the orbiting laboratory.

[Answer] All the necessary equipment and expendables were delivered by the Progress craft. We received and unloaded five cargo ships.

The memorable dates in our marathon flight were the visiting expeditions. First to arrive was an international crew consisting of Yu. Malyshev, G. Strekalov and R. Sharma, citizen of the republic of India. Experiments in three fields were carried out in a program of Soviet-Indian cooperation in space exploration: geophysics, technology, medicine. The international crew with our participation successfully performed the scheduled work program.

The next expedition to arrive (V. Dzhanibekov, S. Savitskaya and I. Volk) was to carry out a spacewalk in order to perform a complicated technological experiment using a universal manual tool. During the spacewalk of Dzhanibekov and Savitskaya we were willing to help, realizing how difficult was their task. But our intervention was not needed: Svetlana and Vladimir functioned superbly. There is no doubt that the spacewalk of Svetlana Savitskaya, the first woman to accomplish such a feat, was a major event in cosmonautics.

[Question] What might we term the major areas of your work on board the station?

[Answer] The main areas in our investigations were the geophysical, astrophysical, biological, biotechnological experiments, experiments in materials science and medicine; visual observations were carried out for geology, oceanology and on behalf of the agricultural, timber and fishing industries. Much of the work basically continued the studies conducted by previous expeditions. At the same time, our expedition was allotted entirely new experiments or experiments with improved apparatus. A traditionally important place in the program is occupied by technical and technological investigations aimed at optimizing instruments and procedures, further development of them, improvement of technology, including space technology. The scientists were very interested in experiments following the Intercosmos program such as Chernoye More and Gyunesh. The main goal of Gyunesh was to improve aerospace studies of the earth under physical-technical and scientific-procedural aspects. This enabled further intense development of the corresponding branches of space-based resource study. Participating in the work were specialists from our country, as well as scientists of Bulgaria, Hungary, East Germany, Cuba, Mongolia, Poland and Czechoslovakia. For the first time, five modifications of aircraft-laboratories were used, outfitted with high-class original apparatus. The experiment verified various alternatives of design of the technical devices and support of the research activity on all levels, beginning with an aerospace control measurement test field. In the experiment Chernoye More, measurements were taken at three levels: from Salyut-7, from airplanes, from marine vessels and a stationary platform in the sea. In this case the Black Sea functioned as a model of the ocean with its characteristic current whorls, ascending waters and shelf zones. In future we will be able to create an automated system for reporting of typhoons, fires and the like; in this way the speed of obtaining information is increased.

The visual and instrument observations--and the experiments Gyunesh and Chernoye More were indeed such--generally were among the most interesting during the space expeditions. For observations on board Salyut-7 there are the KATE-140 and MKF-6M wide-format cameras, portable cameras, the MKS-M and Spektr-15 spectrometers. From the orbit of the station, using the MKF-6M, it is possible to register a rectangular sector 40,000 km^2 in area. And each frame of the KATE-140 topographical camera covers a square with a side of several hundred kilometers. We took thousands of such frames.

[Question] The layman often asks why so many photographs? After all, the previous expeditions also took photographs.

[Answer] As a matter of fact, there are practically never two identical photographs. There is always something new: either a different lighting of the objects (which means that new details are also visible), or a different season, or different weather conditions. It is a process of accumulation of information, after which image synthesizers on earth use computers to analyze these photographs and compile charts. These are refined by aerial photographic survey and ground studies are carried out using them, which allows the prospecting expeditions to work more efficiently. Even today, more than 800 organizations in our country are receiving space photographs. Much in-

formation has been obtained as to rapidly-occurring processes which require a prompt response. Such phenomena include typhoons, fires and moving glaciers.

Especially important was the fact that our crew flew during all four seasons.

[Question] Our press has already reported that studies of x-ray sources were also performed during your experiments. Please tell us more details.

[Answer] Toward the end of our stay in orbit we conducted one of the most important astrophysical experiments with the Siren' apparatus. The Siren' is a Franco-Soviet experiment. It was planned long before the flight preparations of the French cosmonauts. The apparatus includes two x-ray telescopes. Both instruments are designed for spectrometric studies of x-ray sources. In a way, they supplement each other, since the first of these receives the hard x-ray emission, while the second has a high resolution. This equipment enables a study of x-ray emission in the range of 2-800 keV. The crew assembled the equipment; then the hatch of the station was opened and the telescopes aimed at the studied sources. There was a total of 46 observation sessions. Of special interest was a source of elevated activity both in the x-ray and optical ranges during this time. These observations can only be made from orbit, since x-rays do not penetrate the atmosphere of earth.

Having the necessary quantity of such observational material, scientists will be better able to answer many questions involving the structure and evolution of the universe. Such observations also provide specialists with new information about the behavior of plasma, which cannot yet be produced in the laboratory.

[Question] Now it is time to mention several of the technological experiments.

[Answer] The technological experiments were basically conducted by the visiting expeditions. Our crew helped set up the experiments. Work continued in the Isparitel' program, begun in 1979. The equipment for this experiment was created by the Paton Electric Welding Institute of the Ukrainian SSR Academy of Sciences. The experiment was simple in layout. In the airlock chamber, under conditions of weightlessness and vacuum, a crucible was instantly heated by means of an electron gun. The metal or alloy in the crucible was converted into vapor and precipitated on plates situated opposite the crucible. A total of more than 180 such metallized specimens have been obtained in past years.

The modernized layout Isparitel'-M can apply coatings up to tenths of a millimeter thick. It has greater power and faster speed of evaporation. But most important, it is a fully-automated apparatus capable of eight different types of work. For example, it coats not only metals, but also plastics. And not necessarily on glass or metal plate, as previously, but also on polymer film. Finally, it has become a multipurpose unit. We cannot only evaporate, but also melt materials, just like in the well-known Splav and Kristall space-borne ovens.

[Question] But you weren't just working inside the station, were you?

[Answer] Certainly not. The repair jobs in open space made the most impression on us. We believe that the work done by us during six spacewalks is a rather good rehearsal for future major installations.

In future such work will be indispensable for the servicing of systems. For in addition to the fact that the station will become the site of scientific research, it is also becoming a kind of base for repair of components of satellite systems. The experience amassed in the repair work is also valuable in that it forces the crew to learn certain operations "on the move," when already aboard the space station.

[Question] Then perhaps you will briefly mention the factors motivating the complicated installation work in outer space.

[Answer] The Salyut-7 orbital station has two mutually-duplicated lines of a unified engine unit: primary and reserve. The malfunction in the reserve line did not affect the working of the primary. Nevertheless, it was resolved to restore its serviceability and at the same time check out the possibility of conducting such complicated installation work in open space. One of the characteristics of the upcoming operation was the fact that we had to work on the instrument compartment, situated at the opposite end of the station. In order to get there we had to travel between the solar batteries, antennas, and other structural elements of the station. Not only that, but each time we had to carry rather large containers with tools and appliances.

On the first occasion, while moving along the entire station toward the instrument compartment we laid down a special gangway that could be used to reach the site of the upcoming work. Here we secured the tool container and set about the preparatory procedures prior to the work with the reserve line. The panels were opened out and the systems of the line made accessible.

The second time we exited into space three days later. Traveling the identical path as on the first occasion, we continued the work. We installed a valve in the line, conducted a pressurization and checked the tightness of the pipeline. As a result we determined which possible alternative to follow in future. The second walk lasted 5 hours, working with the tools and appliances both on the sunlit side and in the shadow.

During the next two walks we installed two auxiliary lines and checked their seal. All the appliances and tools needed for this were already on board the station, and the crew had been prepared to operate by this procedure already on earth.

[Question] It appears that the experience of the preceding spacewalks enabled you to work quickly and reliably.

[Answer] Absolutely, such experience was very handy. And besides, it was decided to work with the engine unit after the arrival of the visiting expedition, whose crew was supposed to explain the work procedure to us, that is, an in-flight training was conducted.

Prior to the last spacewalk to repair the reserve line we had conducted the fifth spacewalk, during which two auxiliary solar battery sections were installed. The experience gathered in previous flights was very useful in carrying out this procedure: all the installation work took little more than 3 hours. We had to install both panels simultaneously, not one by one, like the previous crew. After installation of the four auxiliary solar battery panels the power of the electrical system of the station was considerably boosted.

When the second visiting crew returned to earth, we carried out our sixth and final spacewalk.

[Question] Six times in one flight! Surely this is an absolute record in the history of world cosmonautics. And one can't call such spacewalks simple strolls.

[Answer] No serious work is simple. Despite the lengthy flight, we were still in excellent physical shape, which assisted us in carrying out the procedures in open space. And there were quite a few procedures. In particular, we had to close off one of the pipes of the fuel line, using a special appliance. For the first time a hermetic clamping of a fuel pipe was performed in open space. The checks demonstrated that serviceability of the reserve circuit was fully restored.

After this, using special tools we disassembled a small portion of the solar battery panel so that the condition of these elements could be carefully analyzed on earth and a determination made as to the outer space conditions that affect the electrical characteristics of the battery.

The overall duration of the six spacewalks was 22 hours 50 minutes.

[Question] Obviously the results of these spacewalks enable a future planning of various installation, repair and scientific work in open space. Does this mean that ground training will lose its importance?

[Answer] Not at all. Actually, the possibility of assembling large orbital complexes using special appliances and tools is becoming a reality. But we make extensive use of special layouts simulating the work of the cosmonauts under weightlessness to prepare the cosmonauts. Excellent results in this area are provided by preparation of the crew in a hydrolaboratory. All the basic elements of the exit, moving around outside and inside the station, and mutual cooperation are developed by the cosmonauts in a water tank, which is a rather good simulator of weightlessness and the working conditions in a spacesuit.

Also important for the preparation is exercises in a barochamber, where the cosmonauts in conditions of a deep vacuum acquire work skills in an actual spacesuit, including work under difficult conditions.

[Question] Obviously new problems require new tools, appliances and cosmonaut training procedures. May we expect that the large experience gathered by Soviet cosmonautics in this area will permit a quick and successful solution of the present problems?

[Answer] The increased flight duration confronts the cosmonauts with the new problem of learning to live and work in outer space so as to return to earth healthy and in excellent shape. The complex of means and methods used to prevent the deleterious effects of weightlessness are constantly being upgraded and supplemented. Their utilization in flight essentially continues the complex of measures which we undergo prior to the flight at the Gagarin Cosmonaut Training Center. The experience of our flight and the previous ones has demonstrated the high effectiveness of such a training system.

[Question] It is evidently no accident that Dr. O. Yu. At'kov was included in the crew for such a lengthy flight?

[Answer] Yes, medical experiments and research occupy a prominent place in a lengthy flight program. Usually they are implemented by cosmonauts with nonmedical training, using procedures and special apparatus developed by medical specialists. In our case a professional physician was on hand, able to conduct systematic studies and observations of the dynamics of our health during the lengthy flight and perform various tests and analysis. This substantially enlarged the range of medical investigations. New instruments and procedures were tested for evaluating the health of the cosmonauts and controlling the adverse changes caused by lengthy exposure to weightlessness and other space flight factors. These studies will have great significance both for practical medicine and theory.

[Question] You accomplished a very large volume of work during the 237 days of flight.

[Answer] Yes. And we hope that the results of this work will find broad application in many fields of science and the economy, serving as the foundation for future improvement of space technology and the activities of the cosmonaut crews.

[Question] Recently in various countries there are increasing calls for protection of the peace on the planet and controlling the arms race, which because of the stance of the imperialist circles threatens to explode into space.

[Answer] An arms race in space is intolerable. Our flight pursued peaceful purposes. It was a concrete implementation of the policies of the Communist Party of the Soviet Union and the Soviet State, aimed at peaceful exploitation of outer space on behalf of all the nations of the earth. And we devoted our flight to the 40th anniversary of the victory of the Soviet nation in the Second World War.

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BLAGOV ON DEVELOPMENT OF COSMONAUT EVA PROGRAMS

Moscow ZEMLYA I VSELENNAYA in Russian No 2, Mar-Apr 85 pp 2-8

[Article by V. D. Blagov: "Man in Space"]

[Text] Twenty years ago, on 18 March 1965, Soviet Citizen A. A. Leonov was the first person to walk in outer space. The significance of this heroic step is hard to exaggerate. V. D. Blagov, second-in-command of the flight and awarded the USSR State Prize, shares with our readers his recollections of that remarkable event, the subsequent stages in man's conquest of outer space, and his thoughts on the future of peaceful cosmonautics.

"Hot on the Trail"

On 2 October 1984 the longest space flight was successfully completed. It demonstrated that the present level of Soviet space technology enables effective functioning in orbit for a long time and a well-planned exploration of outer space for the purpose of exploiting the colossal opportunities afforded by space for the benefit of the economy.

There were many firsts in this flight. Besides a record duration and unusually large volume of experimentation, it was the first time that seven spacewalks were made during a single expedition, of which six were made by the primary crew.

The primary crew operated outside the station for 22 hours and 50 minutes, putting together the solar battery, carrying out unusual assembly work to refurbish the reserve fuel line of the consolidated engine system of the station, and cutting out fragments of the solar battery for investigation of the causes of their reduced efficiency on earth.

For the first time the crew of the visiting expedition (V. A. Dzhanibekov and S. Ye. Savitskaya) also left the station and tried out a universal manual tool combining four functions in a single assembly: welding, cutting, soldering of metals and application of metalized coatings to various surfaces.

Today, 20 years after the world's first spacewalk, Soviet cosmonautics has gained much experience in extravehicular activity. A sophisticated set of equipment has been developed: highly-reliable spacesuits with life support system, airlocks, devices for moving about and anchoring of the cosmonaut on board the craft, a set of special tools, exterior lighting, television and communications apparatus. The number of special tools used, e.g. by L. D. Kizim and V. A. Solov'yev in the assembly work with the consolidated engine system, comprises 35 items. The high level of intellectual activity of the tool developers is indicated by the fact that roughly 90 percent of the tools used have been acknowledged as inventions.

The procedures for carrying out various operations in space have been worked out: replacement of scientific apparatus installed on the outer surface of the station; assembly of the solar batteries; opening of the panels of the station for access to the assemblies, installation work at the hydraulic mains of the ZhRD [liquid rocket engines], welding, cutting, soldering, drilling of metals, application of coatings, bolt fastening and so on.

Despite the accumulation of much experience and availability of sophisticated equipment, extravehicular activity today, the same as 20 years ago, is one of the most complicated flight operations requiring large energy expenditure by the cosmonaut and associated with high risk. During the first spacewalk, for example, L. D. Kizim and V. A. Solov'yev performed 45 actions.

That is why all activities must be carefully checked out on earth, refining all procedures to the level of an automatic response (an instruction pack cannot be taken into outer space) and playing out unusual scenarios. An equipment complex has been built for this purpose, enabling a high level of training for the cosmonauts: an airborne laboratory for playing out individual spacewalk activities in weightlessness, a hydrolaboratory for complex optimization of all spacewalk and extravehicular activities; various stands for teaching how to use the tools and tethering equipment.

With these simulators, L. D. Kizim and V. A. Solov'yev performed a total of 25 spacewalk exercises and played out 182 possible unusual scenarios. The training for the last spacewalk and pipeline clamping had to be done on board the station already in flight, since the flight program did not envision this operation prior to launch. A video film taken at the hydrolaboratory, a section of the layout of the systems compartment of the station with the pipelines and a new tool for clamping the pipeline were sent to the station. The in-flight trainer was V. A. Dzhanibekov, who underwent a training cycle in water tank prior to his flight.

All of the above became possible not at once or even in a year. They were the fruit of many years intense effort of a large group of methodologists, designers, workers, cosmonauts and flight control specialists.

Into the Unknown

As far back as 1919 K. E. Tsiolkovskiy began work on his book "Life in the Interstellar Realm." Many of the ideas first enunciated by him have now been implemented. The great scientist believed that in time man would become "a mighty inhabitant of the aether" and would work in open space. But this necessitates an appropriate protection against the harmful influence of the "vacuum of the aether."

Later on academician S. P. Korlov stated that, unless it is possible for man to emerge into open space, "...the blazing of new trails in space is inconceivable.... Doubtlessly during flight it will be necessary to transfer from one vessel to another to render assistance if needed or to make inspections or repairs in flight, which will significantly enhance the safety of the voyages.

"Leaving the spacecraft will facilitate certain scientific investigations.... We know that this is entirely feasible at the current state of technology...."

In 1963, still prior to the flight of the three-man Voskhod, Korolev confronted a group of project designers with the problem of elaborating the technical possibility of a spacewalk from a modified Voskhod.

As the designers involved in this project recall, the tremendous technical complexity of the task was scarcely understood at the time. For the group this was a new and interesting problem where each could display his creative talent. Several alternatives were examined.

First. Depressurization of the cabin and exit into space through the hatch used by the crew to enter the ship during launch. The plus of this alternative is the simple enactment. The drawbacks: necessity of pressurization of a number of instruments not able to function in a vacuum; loss of air from the cabin with each exit. This alternative was subsequently acknowledged as unpromising.

Second. Creation of an airlock in the Voskhod-2 cabin with two hatches, inner and outer. The drawbacks of the first alternative were eliminated, but the relatively small dimensions of the cabin made it hard to allot the necessary space for the airlock. This alternative was also rejected at the time. (Afterwards, however, it was realized aboard the Soyuz-4 and 5 and the Salyut-6 and 7.)

Third. Situation of a lock chamber at the outside of the craft. This eliminated the drawbacks of the first and second alternatives, but required a collapsible lock chamber, since it must be accommodated beneath the nosecone, which covers the vessel during the atmospheric segment of orbital injection. Naturally, this complicated the design of the chamber itself.

The designers wanted to find an alternative with maximum possible simplicity, but such is almost never the case in technology. They worked with enthusiasm,

long into the night with no breaks. Korolev interested himself each day in the course of the alternative designs, visited the workroom and sat beside each in turn, silently ruminating.

Various designs of the lock chamber were reviewed for the third alternative. The final choice fell to a design having a number of inflatable air-beams and a special system for inflation and separation from the ship. The blueprints were soon developed and the first model of the lock chamber was built.

New suits were developed for the spacewalk. These were quite different from the previous ones. Thus, they had an independent personal life-support backpack system. The outer skin was white, to reflect the sun's rays. On the helmet there was installed a dense light filter to protect the eyes against bright sunlight. A second hermetic layer was introduced into the skin. The safety of the cosmonaut was assured by a special tether, 5 m long, in which cables were installed for the communication and telemetry system.

Physicians tackled a new problem: what would be the behavior of the first person to walk in space? Some believed that agoraphobia might occur and quickly unfold during such conditions, paralyzing the actions and the willpower. But others, on the contrary, presumed that the person would quickly adapt to the new situation, as was the case with weightlessness. The words of Tsiolkovskiy were remembered: "...strong nerves will quickly adapt and fear vanish." But only the flight could answer all the questions.

Of course, the personality and psychology selection of the crew was extremely important. After all, this would be the first experiment involving a walk in open space. The crew was organized by the time the training began. The ship commander was P. I. Belyayev, while A. A. Leonov was chosen to perform the first spacewalk.

Belyayev was a person of strong will, endurance, self-control, very persistent and distinguished by logical thought processes and deep self-analysis. Leonov was lively, impetuous, able to develop enthusiasm in any situation while displaying boldness, decisiveness and persistence. Together they made an excellent team.

Finally, the testing of the ship, spacesuits and lock chamber was over and the training of the crew was completed. The control group had been put together and trained. Then came a significant event: the State Commission approved the flight program.

According to the program, Voskhod-2 was to be launched on 18 March 1965 and was to make 16 orbits around earth. Leonov was scheduled to move into the lock chamber during the very first orbit, after the pressurization system was checked out. Automatic instructions took care of the normal opening and inflation of the lock chamber. The ship commander opened the inside hatch of the lock chamber from his console and then Leonov passed in.

During the second orbit, when Voskhod-2 had reached the zone of visibility of the ground tracking station, the outside hatch of the lock chamber was opened. Leonov was now in the deep vacuum of outer space. At 11:34:51 he left the lock chamber. Belyayev reported to earth: "Man has walked out into space!"

Leonov removed the cover from the motion picture camera and set about the experiments prescribed by the program. He made five departures and approaches to the rim of the lock chamber. All his actions were recorded by the movie camera and sent by television to earth. Leonov made observations of the earth, evaluated the ease of working in a spacesuit and the visibility through the light filter, and analyzed his feelings.

Afterwards, remembering the experience, Leonov said: "I am often asked, was there any unusual acuteness when I strode into space? Frankly, no. Not even a chill. Only the most enjoyable sensations. I felt nothing but lightness and freedom. In my opinion, the most important factor for staying calm is comprehensive preparedness.... And one more secret: the spectacle of the cosmic abyss so enthralled me that there was no room for any other sensations. You just catch sight of the beauty and then go to work." And most important: "It is possible to work in space!"

Once the spacewalk program was completed, it was time to return to the cabin. Leonov spent 12 minutes 9 seconds outside the ship. Afterwards this result was to be acknowledged a world record by the International Aviation Federation (FAI).

After Leonov returned to the ship, the flight of Voskhod-2 lasted another 24 hours. The crew performed a complex of visual observations. Early on the morning of 19 March the flight program of Voskhod-2 was finished. The preparation for touchdown began. The lock chamber was ejected. The automatic attitude control system was activated. Belyayev reported that the automatic attitude-control system was not responding. This meant that the ship could not be set down in automatic control. For the first time in the history of manned space flight, manual control had to be used. After analysis of the situation, ground control approved the use of manual control in orbit 18.

Belyayev activated the manual attitude-control system and, using the Vzor sighting instrument, oriented the ship with respect to the three axes: pitch, yaw and roll, and then activated the retro-engine. And on 19 March 1965 at 12:02:17 the descent capsule with cosmonauts P. I. Belyayev and A. A. Leonov touched down 180 km northwest of the city of Perm'.

To Work in Outer Space

After the successful spacewalk experiment it was possible to advance to the practical solution of problems involving the development of orbital stations, firm mastery of space and its exploitation for the benefit of the nation. The world's first link-ups of the unmanned craft Cosmos-186 and Cosmos-188 on 30 October 1967 and Cosmos-212 and Cosmos-213 on 15 April 1968 confirmed the theoretical possibility of assembling large space stations in orbit.

In January 1969 the Soviet Union conducted an experiment to develop a manned space station. The Soyuz-4, manned by V. A. Shatalov, and the Soyuz-5 with cosmonauts B. V. Volynov, Ye. V. Khrunov and A. S. Yeliseyev on board carried out an approach and docking. Thus, on 16 January 1969 the world's first experimental space station was constructed in orbit and began functioning.

One of the important stages of this flight was the spacewalk of Khrunov and Yeliseyev, transferring from Soyuz-5 to Soyuz-4. The operations of crew exchange and crew rescue in an emergency in orbit were worked out for the first time. The simultaneous sojourn of two cosmonauts in open space lasted 37 minutes.

The first Salyut orbiting science stations began to operate in 1971. In 1977, the Salyut-6/Soyuz/Progress orbiting scientific research complex began working in space.

The programs of the first and second main voyages to Salyut-6 involved spacewalks. On 20 December 1977 cosmonauts Yu. V. Romanenko and G. M. Grechko had to conduct a careful inspection and check-out of the state of the exterior elements of the station and the docking unit. The outcome of this inspection was to decide whether a docking was possible from the transfer compartment of the station after the docking attempt of Soyuz-25 in October 1977 proved unsuccessful.

Cosmonauts Grechko and Romanenko were in open space for 1 hour 28 minutes. The outcome of this work was doubly successful. Not only was it possible to inspect the docking unit and draw a positive conclusion as to its serviceability, but a new spacesuit, which became a major advance in spacesuit design, was tested at the same time.

On 29 July 1978 V. V. Kovalenok and A. S. Ivanchenko also walked in space: this time to disassemble specimens of structural materials spending more than 300 days on the outer surface of the station. The cosmonauts spent 2 hours 5 minutes in open space.

Thus, in little more than 13 years the cosmonauts of the USSR and the U.S. astronauts repeated the feat of A. A. Leonov a total of 21 times.

In August 1979 cosmonauts V. A. Lyakhov and V. V. Ryumin were nearing the end of their flight aboard Salyut-6. The KRT-10 radiotelescope, delivered by the Progress-7 transport ship, was assembled on board the station for the first time. Using this telescope and the huge RT-70 ground radiotelescope of the Center for Remote Space Communications in tandem, a series of astrophysical studies was conducted.

An unexpected event happened toward the end of the flight on day 171. The antenna of the telescope in separating got stuck on the docking target of the station and continued to fly in this manner with the station. A very complicated situation was created. The cosmonauts were very tired. Yet there was

no experience with extravehicular activity after such lengthy stay in weightlessness. There were large doubts as to the successful accomplishment of this difficult work.

But the station could not be left in this condition either. It would not be possible to dock the Progress cargo ship (the unit was covered by the antenna), nor the Soyuz ship, since the loosely-attached KRT-10 antenna interfered with the inertial characteristics of the station and it would not be able to accurately orient the docking unit vis-a-vis the ship during the approach.

After discussing the situation with the physicians and the cosmonauts, a joint decision was taken: the cosmonauts would go out into space, using the railings, skirting the entire station and reaching the end of the large diameter of the working compartment, where they would detach the antenna and remove it from the station.

After spending 1 hour 23 minutes in open space, the cosmonauts spectacularly dealt with this problem. The station was saved.

It must be mentioned that a total of six main expeditions were made to the Salyut-6 station, which was in ac ive operation in space for around five years, performing a large volume of scientific work. Furthermore, cosmonauts from the socialist countries of Czechoslovakia, East Germany, Poland, Hungary, Cuba, Vietnam, Mongolia and Rumania stayed aboard the station during the Intercosmos program.

The new station Salyut-7 began to function in orbit on 6 April 1982, when all the facilities of Salyut-6 were used up.

On 30 July 1982, after a 78 day flight, A. N. Berezovoy and V. V. Lebedev walked in space. The goal was to disassemble and partially replace the scientific apparatus mounted on the outer surface of the station. In addition, the cosmonauts performed a number of technological operations and checked out a new tool designed to perform assembly work outside the station. They spent 2 hours 33 minutes in space. Joint work was also done with a Franco-Soviet expedition and a visiting expedition including the female cosmonaut S. Ye. Savitskaya.

V. A. Lyakhov and A. P. Aleksandrov during their 150 day flight aboard Salyut-7 walked in space on two occasions and set up auxiliary solar batteries, enabling a one-third increase in the power capacity of the Salyut-7/Soyuz T/Progress science complex. Lyakhov and Aleksandrov spent a total of 5 hours 45 minutes in open space.

Construction in Space

Thus, as cosmonautics developed it became routine to work in outer space. The space flight programs bring up new and complicated problems which increasingly require a solution outside the station. This is a natural process. A shining

example is the unique work done in outer space by cosmonauts L. D. Kizim, V. A. Solov'yev, V. A. Dzhanibekov and S. Ye. Savitskaya, as reported at the beginning of the article.

Today we are equipped with a whole arsenal of means and methods for performing various work in open space. But how will the gathered experience be used in future?

In the near future the conquest of space will evidently proceed in the manner predicted by K. E. Tsiolkovskiy, who wrote: "...dwellings and all their appurtenances should be delivered in the collapsed (compact) form by rockets from earth and assembled in space upon arrival at their location." This would entail a future development of large orbiting stations and multipurpose production complexes, which are already beginning to be assembled in orbit from modules and smaller parts delivered from earth.

Moreover, even today the conquest of space poses important problems that cannot be solved without the new space vehicles using individual elements and appliances exceeding in size the dimensions of the cargo containers of the present booster rockets. The assembly and even manufacture of such elements will have to be done directly in space.

This concerns primarily the various kinds of large antenna needed for observations of the earth's surface and remote astrophysical objects in various ranges of the electromagnetic spectrum, meeting the needs of television, communications and navigation, and providing for retransmission to earth of signals from probes exploring the distant planets of the solar system. For the working effectiveness of such instruments (sensitivity and angular resolution) increases with the area of the receiving antennas.

Second, there are solar batteries providing the requisite power to the systems of the space vehicles: even today their useful area is 50-100 m^2. The construction of large-scale solar batteries requires direct human involvement (let us remember the experiments by V. Lyakhov and A. Aleksandrov).

Both types of large-scale structures (radio antennas and solar batteries) are basic components of the future solar electric stations, projects for which are currently being discussed intensively in the scientific literature. Several projects are examining solar batteries with an area up to 100 km^2, and the diameters of the microwave antennas for transmission of energy to earth should be nearly a kilometer. Such power stations and factories, albeit not requiring constant human attendance on board, do entail direct participation of the cosmonauts in their assembly, adjustment, operational checking and repairs.

Recently there have been many projects for large-scale multipurpose platforms that can be used for purposes of communication, astronomy, meteorology, navigation and earth studies. Of course, broad use of such facilities requires the development of various kinds of automation for their assembly. But apparently man will always supervise the assembly operations and perform the delicate work of adjustment and repair. This, at any rate, will long remain his prerogative.

Finally, the construction of scientific bases on the moon and other planets of the solar system and the organization of large space colonies of the distant future require the combined efforts of all the nations of our planet and new design solutions, such as even the boldest engineering imagination cannot envision today.

The space construction industry of the future should play an important part in the life of humanity and assist in the transformation of nature for practical uses. It is therefore criminal to waste enormous resources on the development of space weapons. There should be an international and total ban on the placement of military satellites in space, which provide no benefit to the peoples of the earth, and the redeemed funds should be allocated to the development of outer space for peaceful purposes.

12717
CSO: 1866/4

COMMENTS ON SOVIET-FRENCH PROJECT FOR 'GAMMA-1' ORBITAL TELESCOPE

Moscow IZVESTIYA in Russian 10 Mar 85 p 2

[Article by G. Alimov: "Star Gamma Rays for Three Telescopes -- Scientists Comment on Launching of Special Space Observatory"]

[Text] Soviet and French scientists soon will "put on the road" a telescope such as has never been seen before. In essence, such a large observatory will be put into space for the first time. Its electronic instrumentation with automated processing of observational data, such an unusually clever robot, would indeed be envied by any surface observatory.

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...Grandiose explosions in the depths of the Universe frequently last but instants, some short fractions of a second. But in such events there is a release of energy equal to the radiation of the sun over the course of many years. Just what is this? What is the cause of the gigantic cataclysms? Space, distant, inaccessible, is seething. Unexpectedly, mysteriously, traces of unparalleled catastrophes are discovered first in one and then in another region of the sky. Ten years ago a space vehicle "picked up" strong pulsating radiation in the constellation Vela, in Crab nebula...

Today it is not adequate just to observe the sky. Moreover, optical telescopes have a limit of visibility. Accordingly, during the last two decades a number of new directions in space research have been defined. And each new branch of astronomy casts new light on the Universe. That is precisely what happened when radio astronomy, for example, was added to the old, traditional optical astronomy. Many celestial features which could not be seen with ordinary telescopes, and that means that they simply did not exist for earthlings, immediately "found their voice." They were registered on magnetic tapes and this information was used in retrieving the picture of the radio sky. Space began to speak in different voices! Even now it is impossible to visualize modern astronomy without radio telescopes. And now other telescopes which can be used only in space are already assuming a role. The optical and radio ranges are being supplemented by new ranges -- IR, X-ray, UV. Extremely interesting results giving a great impulse to the development of astrophysics have already been obtained in each of these directions.

And now gamma astronomy has come along. It has gained the rights of "terrestrial citizenship." Scientists regard this direction to be one of the most fundamental. Much is expected from it. However, gamma astronomy has succeeded in acquiring rights of "space citizenship" as well. Several apparatuses have already been put beyond the earth's limits. It is true that they were small, but they learned quite a bit which is of interest and posed before scientists more questions than they helped in casting light on the unknown.

This also explains the striving of astrophysicists to launch into space another apparatus which is more perfect and specifically intended for carrying out a large-scale experiment for studying the nature of mysterious cosmic radiation. This project has received the name "Gamma-1."

R. Z. Sagdeyev, academician, director, Space Research Institute, USSR Academy of Sciences:

Information on gamma radiation is of importance not only for astrophysics. It can expand the frameworks of those physical phenomena within which we have already established laws. It is not impossible that it will help in discovering new physical laws as well. The checking of our concepts concerning the structure of matter is occurring specifically at the boundary of the unknown; precisely here there can be a bridging between astrophysics and the physics of elementary particles. The gamma quanta ejected at the time of large-scale cosmic explosions arrive at the earth from a singular natural laboratory where matter is already in an extremal state: superhigh temperatures, extremely strong magnetic fields and radiation fluxes. Such conditions are very difficult to create in terrestrial laboratories. Not only because this would be inconceivably expensive, but on the earth there simply would not be the room or physical possibilities for this.

During the last 10 years a total of 30 sources of cosmic gamma radiation have been discovered. Including those flaring for a short time. As a comparison: the catalogues of optical stars contain hundreds of thousands of objects and the catalogue of X-ray stars -- several thousands. Scientists have quite precisely determined for some of the gamma stars the region of the sky in which they are situated. But many of them have not been identified with any known space object whatsoever. Without this it is impossible to understand what these mysterious gamma stars are, which are so unlike others, and what is the reason for the grandiose gamma bursts in the depths of what in essence is unknown space. For earthlings this is truly virgin territory in space. The path of gamma astronomy was thorny. In general the path to the stars, as is well known, is thorny. The radiation fluxes predicted initially by theoreticians were exaggerated, but the experimental apparatus available at that time was used at the limit of its capabilities. It is probable that gamma stars are variable in time and this possibly was the reason for the errors in the first experiments.

V. G. Kirillov-Ugryumov, professor, scientific director of the "Gamma-1" project:

We expect a detailed picture of the sky in gamma rays from the space observatory. This will make it possible to understand the still mysterious nature of

gamma stars, their possible relationship to known astrophysical objects observed in the optical, X-ray and radio ranges. Here it is necessary to have a higher accuracy in the measurement of space coordinates, time and energy spectra than was the case in the first exploratory studies. A new stage in the investigation of space is the launching of the "Gamma-1" telescope. It will help in solving the problem of the sources of cosmic rays -- a highly important constituent of interstellar and intergalactic space. It possibly will also make it possible to see the most distant, and this means the youngest regions of the Metagalaxy, to solve a whole series of problems related to the birth, life and death of stars and galaxies.

The "Gamma-1" project is the result of many years of work of Soviet and French scientists. This cooperation already began in the 1970's when a program was drawn up for long-term cooperation in the field of gamma astronomy. Real businesslike relationships were established among scientists. All behind are numerous experimental models of telescopes, tests in vacuum chambers, on centrifuges and on vibration stands...

Now the next tests of the space observatory are in progress. I see how white meteors flare and die out on the display screen in a blink of an eye, leaving trails behind them. The "Gamma-1" telescope detects the "cosmic" gamma radiation emanating from a terrestrial accelerator. The sensitivity of the telescope and the operation of all its on-board systems are being measured.

V. M. Balebanov, candidate of physical and mathematical sciences, deputy director of the "Gamma-1" project:

A space apparatus was developed especially for implementation of the "Gamma" experiment. It will be able to carry almost two tons of scientific instrumentation. The observatory will be launched to an altitude of 350 km. On the ship, in addition to the main large "Gamma-1" telescope, there will be a gamma telescope of a lesser size and also an X-ray telescope. The principal merit of our main telescope will be a high angular resolution and sensitivity. Incorporated in the instrument for this purpose, for example, are wide-gap spark chambers developed at the Moscow Physical Engineering Institute and a coding "screen" developed at the Space Research Institute. This innovation will make it possible to observe the entire area of the celestial sphere in which the dipper of Ursa Major could fit. Within this area the telescope will see point and extended sources, the entire region of the sky in gamma rays. All the telescopes must be pointed into strictly stipulated regions of the star sky with a high accuracy. Our space vehicle will ensure such a possibility.

The ship will carry special instruments for more precise determination of current orientation in space. These instruments were developed by the scientists and engineers of the Polish Academy of Sciences. In case of necessity specialists will be able to control the observatory. Hundreds of different commands are incorporated in its work program. The duration of observation of one region of the sky will vary from one week to a month. Data from the terrestrial envoy will arrive several times a day.

Star gamma quanta are flying from space, bringing mysterious light of the Universe to us. We earthlings must try to understand what secrets these signals from the head-spinning distances of the heavens are carrying.

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CSO: 1866/86

UDC 520.874.3

POSSIBILITY OF INVESTIGATING STAR SYSTEMS BY RADAR

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 62, No 3, May-Jun 85 (manuscript received 28 Oct 83) pp 500-505

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[Abstract] There is no fundamental reason why radar cannot be used in investigations of star systems. In order to detect star systems by radar it is necessary to construct an antenna with a diameter of several tens of kilometers and a transmitter whose power is commensurable with the power of all electric power stations on the earth. Such an antenna should be in outer space in order to avoid the influence of radio ray refraction in the earth's troposphere and not to give rise to radio noise. At present the construction of such a radar apparatus may seem incredible, but there are no fundamentally insoluble problems. The closest stars are 10,000 times more distant from the sun than Pluto. In order to make successful radar observations of star systems there would have to be the same "jump" in energy potential as with the transition from radar observations of the moon to radar observations of Pluto. If the rates of increase in energy potential persist, radar observations of star systems will become realistic by the middle of the 21st century. A system for interstellar communication having a receiving antenna with an effective area of $2 \cdot 10^9$ m^2 operating at a wavelength of 3 cm with a receiver noise temperature of 10 K can ensure transmission of a television signal from a distance of 4.34 light years with use at the transmitting end of an antenna with a diameter of 10 m and a transmitter with a power of 10^5 W. Radar observations of star systems will open the way to interstellar ships in the same way that radar observations of planets in the solar system opened the way for interplanetary stations. Figures 1; references: 4 Russian.
[11-5303]

UDC 520.062

USE OF LIQUID MIRRORS IN ASTRONOMY

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 62, No 3, May-Jun 85
(manuscript received 20 Jan 84) pp 598-601

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[Abstract] The development of a liquid telescope with a mirror placed in a rotating system of intermediate damping fluids is discussed. Experimental data indicating the advantages of use of this method in astronomy are given. The examination of this problem indicates that the use of liquid mirrors is far more promising than is usually assumed and the designing and construction of large zenith telescopes with a liquid objective is feasible. As a highly reflecting liquid it is possible to use mercury with a protective layer of glycerin or a gallium melt. In addition to having a high-quality surface, a liquid mirror is incomparably cheaper and more easily produced than a traditional mirror, is not subject to thermal and static deformations and has a controllable surface configuration. A system of such telescopes at different latitudes can be irreplaceable for problems of the scanning-search type. The use of a liquid mirror in a vertical solar telescope would not even require changes in its basic optical system. The simplicity of this method makes it use possible in the construction of ultralarge objectives for future generations of telescopes operating in both optical and microwave ranges. There is no need for mechanical processing of the mirror surface and efforts necessary for producing adequate materials and means for their hardening during the rotation process are justified.
References 10: 7 Russian, 3 Western.
[11-5303]

UDC 521.322:176

PROCEDURE FOR INTEGRATING EQUATIONS FOR ELEMENTS OF INTERMEDIATE SATELLITE ORBIT

Moscow ASTRONOMICHESKIY ZHURNAL in Russian Vol 62, No 3, May-Jun 85
(manuscript received 6 Jan 84) pp 590-597

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[Abstract] One of the most perfect models of intermediate motion of a satellite is the orbit of the generalized problem of two fixed centers which takes into account the second and third zonal harmonics in the expansion of planetary gravitational potential. However, until now the equations for the elements of such an intermediate orbit have been solved only in the first approximation and there has been no clearly defined scheme for their integration in subsequent approximations. Sinc for an intermediate orbit, taking the earth's oblateness into account, the perturbing factor is

1,000 times less than for a Keplerian orbit, the solution is simpler. The coefficients of the equations for such an intermediate orbit and the perturbing function are represented in the form of expansions in powers of the earth's oblateness and it is an unwieldy problem to write these expansions. This article clarifies what operations must be performed and what expansion terms must be taken into account in order to obtain perturbations of the elements of an intermediate orbit with an accuracy to a stipulated power of the earth's oblateness applicable to an intermediate satellite orbit based on an asymmetric variant of the generalized problem of two fixed centers. The problem is solved on the assumption that secular and short-period perturbations must be determined with an accuracy to the third power of the earth's oblateness and long-period perturbations with an accuracy to the second power of oblateness. Such perturbations must be taken into account in order to ensure an accuracy of the theory of about 20 cm and its application in the problem of determining the coefficients of expansion of geopotential from observations. In order to simplify the solution only perturbing factors of a gravitational nature are considered. References 9: 8 Russian, 1 Western.
[11-5303]

UDC 524.35-6

OPTICAL RADIATION AND RADIO EMISSION ACCOMPANYING COSMIC GAMMA BURSTS

Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 11, No 6, Jun 85 (manuscript received 2 Jul 84, after revision 29 Mar 85) pp 444-447

VZOROV, N. N., GORBACHEV, L. P., MATRONCHIK, A. Yu. and MOZGOV, K. S., Moscow Engineering Physics Institute

[Abstract] In order to register cosmic gamma radiation with an energy > 10 GeV and fluxes 10^{-11} quantum/cm^2·s it is necessary to have greater areas of detectors than those now present on spacecraft. C. Castagnoli, et al. (NUOVO CIMENTO, Vol 6C, p 327, 1983) proposed that gamma quanta with energies 10-10^4 GeV be registered on the basis of records of Cerenkov flares from relativistic electrons of extensive atmospheric showers caused in the earth's upper atmosphere by primary gamma quanta using large solar antenna arrays at nighttime. With that proposal taken into account, the authors have evaluated the intensity of the light flashes excited in the atmosphere by gamma bursts. Calculations are given showing that the maximum intensity of atmospheric glow in the band λ = 3914 A will be $I_{max} = 10^{-6}$-10^{-2} erg/cm^2·s. In the case of the powerful gamma burst of 5 March 1979 $I_{max} = 2 \cdot 10^{-6}$ erg/cm^2·s. It is concluded that light flashes of this intensity can be registered using the large solar antenna arrays which it is proposed be used for measuring the Cerenkov radiation (with an intensity ~10^{-7} erg/cm^2·s) from high-energy gamma quanta. The intensity of the light gamma flashes excited in the atmosphere by gamma bursts (10^{-2}-10 MeV) in order of magnitude coincides with the intensity of the Cerenkov radiation excited by electron

showers from gamma quanta (10-10^4 GeV) so that these flares must be taken into account in the registry of high-energy gamma quanta. Since there is a common nature of the mechanism for generation of optical and radio signals, they can be used together in the registry of cosmic gamma bursts. Figures 2; references 10: 6 Russian, 4 Western.
[6-5303]

UDC 523.6

COMETARY ICE HALO AND TEMPERATURE OF INNER COMA

Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 11, No 6, Jun 85 (manuscript received 28 Aug 84) pp 475-480

BISIKALO, D. V. and STRELNITSKIY, V. S., Astronomical Council, USSR Academy of Sciences, Moscow

[Abstract] A study was made of the influence of an ice halo on the temperature of the inner coma of a comet for a comet of average brightness situated at a heliocentric distance 1 a.u. It is shown that the presence of a halo can greatly smooth the temperature minimum, increasing the minimum temperature by several times. A hydrodynamic model of the inner coma was computed with the following assumptions: there is a stationary spherically symmetric flow of gas and ice particles; the cometary nucleus, gas and ice particles consist only of H_2O; the ice particles are accelerated by the gas, but the gas does not experience significant slowing in the process; at the nucleus surface the gas velocity is equal to the speed of sound so that the entire gas flow is supersonic; the gas is heated due to photodissociation of molecules by an unattenuated flux of solar radiation and as a result of the entry into it of thermal molecules evaporating from the surface of ice particles; the gas is cooled only due to expansion; the surface temperature of the nucleus and ice particles is determined by the balance between the processes of absorption of solar radiation, evaporation and thermal radiation and is stipulated as a constant parameter; the ice particles are spheres of an identical radius with an identical evaporation rate over the entire surface. With this formulation of the problem, the estimates made in this article and the results of earlier computations show that with this model it is possible to clarify the principal characteristics of gas flow and its thermal state in the inner coma. It is demonstrated that cooling in the inner coma can be considered negligible at distances up to ~10^3 km from the nucleus. Figures 1; references 12: 4 Russian, 8 Western.
[6-5303]

UDC 523.4

INFLUENCE OF SURFACE STRUCTURE OF CELESTIAL BODIES WITHOUT ATMOSPHERES ON POLARIZATION CHARACTERISTICS OF REFLECTED LIGHT

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 19, No 2, Apr-Jun 85
(manuscript received 27 Jan 84) pp 165-173

KOLOKOLOVA, L. O., Main Astronomical Observatory, Ukrainian Academy of Sciences

[Abstract] Observations of celestial bodies without atmospheres and laboratory experiments with terrestrial samples indicate that the plane polarization of the light scattered by them is sensitive to the composition and structure of the surface. The dependence of the degree of polarization P of scattered light on phase angle α is the most informative. With this taken into account, the author applied the geometrical optics approach in examining the scattering of light on a spherical body covered by randomly scattered fissures. Single and double reflection and shadow effects are taken into account. It was found that the curve of the dependence of the degree of polarization on phase angle has a negative branch only when the angle between the surfaces is close to 90°. The methods of the mathematical theory of planning of an experiment were used in investigating the influence of the indices of refraction and absorption of matter and surface structure on the polarization characteristics of scattered light. Surface structure was found to be the principal factor responsible for the depth and shape of the negative branch of polarization. Asteroids of different types differ substantially with respect to surface structure despite a quite similar nature of surface layer matter: the value of the complex refractive index of this matter is considerably greater than the corresponding value for surface layer matter of the Galilean satellites of Jupiter. Accordingly, any quantitative theory of light reflection by bodies without atmospheres must include parameters determining surface structure. Application of such a theory would otherwise result in quite incorrect conclusions concerning the nature of the surface layer. Figures 4; tables 1; references 16: 6 Russian, 10 Western.
[7-5303]

UDC 521.61:550.385.36:550.388.2

SIMULTANEOUS OBSERVATIONS OF LONGITUDINAL CURRENTS, STREAMS OF CHARGED PARTICLES AND IONOSPHERIC GLOW DURING POLAR SUBSTORM OF 30 DECEMBER 1981 BY ARTIFICIAL EARTH SATELLITE 'INTERCOSMOS-BOLGARIYA-1300'

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 25, No 2, Mar-Apr 85 (manuscript received 13 Jun 84) pp 328-331

ZHUZGOV, L. N., ZAYTSEV, A. N., KUZMIN, A. K., LAZAREV, V. I., PAPITASHVILI, V. O., PETROV, V. G., TELTSOV, M. V., TYURMINA, L. O., SI'AROVA, V. A. and SHKOLNIKOVA, S. I., Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, USSR Academy of Sciences; Space Research Institute, USSR Academy of Sciences; Nuclear Physics Scientific Research Institute, Moscow State University

[Abstract] A simultaneous study was made of longitudinal currents, streams of charged particles penetrating into the ionosphere and ionospheric glow at the time of the polar substorm of 30 December 1981 on the basis of the results of observations by the artificial earth satellite "Intercosmos-Bolgariya-1300" and their comparison with magnetic data from ground observatories situated in the auroral oval near the projection of the satellite orbit. The data were used in formulating a model of substorm development. It was found that there is a good consistency between the observed phenomena and existing models of development of a polar substorm. During the course of this substorm the auroral oval expanded in the evening sector MLT to ~20° along the meridian and was displaced toward the equator to $\Phi' \approx 55°$ and the large-scale system of longitudinal currents became stratified, probably due to reciprocal penetration of the easterly and westerly electrojets. The electrical currents flowing from the ionosphere were caused by electrons with E = 1-3 keV leaking into the ionosphere. The observed inflowing electrical currents coincide with a decrease in the flux of electrons with E = 1 keV and cannot be generated by fluxes of leaking ions with E = 0.4-15 keV. In the region of auroral curvature, moving westward, satellite instruments registered discrete auroral arcs, an intensive longitudinal current with a density 10^{-5} A/m^2, directed from the ionosphere, and intensive streams of leaking electrons with characteristic "humped" spectra and a maximum in the energy range 1-3 keV. Figures 2; references 9: 5 Russian, 4 Western. [3-5303]

UDC 550.383

COMPARISON OF THREE SATELLITE MODELS OF MAIN GEOMAGNETIC FIELD

Moscow GEOMAGNETIZM I AERONOMIYA in Russian Vol 25, No 2, Mar-Apr 85
(manuscript received 17 May 84) pp 343-345

BENKOVA, N. P. and KOLOMIYTSEVA, G. I., Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation

[Abstract] There has been renewed interest in representation of the main geomagnetic field by the spherical harmonic analysis method. This article gives the results of a comparison of the model based on "Cosmos 49" data with two other purely satellite models based on OGO and "Magsat 6/80" data. The flight altitudes of these satellites, the measured elements and the heliogeographical conditions under which the surveys were made were extremely different. The comparison made it possible to evaluate: influence of coverage of the earth's surface, effect of the surveys being made from different altitudes and adequacy of component and scalar models. The results obtained by different authors are compared and analyzed. The comparison revealed that in order to obtain sufficiently reliable spherical harmonic coefficients it is necessary that the data cover all or almost all of the earth's surface. Magnetic surveys from artificial earth satellites whose orbital inclination is less than ~75-80° do not provide an accurate determination of zonal harmonics. The making of surveys at different altitudes ("Cosmos" and "Magsat" at altitudes 300-500 km, OGO at altitudes 400-1,500 km) had no significant effect on the three considered models. If the only objective of the model is an approximation of the main field, it is entirely admissible to use data from high-orbit artificial earth satellites. (In studying the anomalous field a low altitude of the artificial satellite is of decisive importance.) Figures 1; tables 1; references 6: 2 Russian, 4 Western.
[3-5303]

UDC 523.682+520.874.3

MEAN DENSITY OF METEOR STREAM INCIDENT ON EARTH

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 284, No 4, Oct 85
(manuscript received 26 Nov 84) pp 824-826

BABADZHANOV, P. B., academician, Tajik Academy of Sciences, BIBARSOV, R. Sh., GETMAN, V. S. and KOLMAKOV, V. M., Astrophysics Institute, Tajik Academy of Sciences, Dushanbe

[Abstract] Accumulated observational data made it possible to determine the density of the streams of meteors incident on the earth in a broad range of masses from (10^{-3} to 10^{2} g). Allowance for instrument selectivity factors is the main difficulty in determining the incident stream. A simple method

has been developed for eliminating the influence of most of these factors. The law of mass distribution of meteor bodies in some finite range of masses is $N(m) = Bm^{1-s}$, where N(m) is the number of meteor bodies with a mass greater than m intersecting some fixed area during a fixed time, B and s are constants. B = const only in the case of constancy of the area which the meteor bodies intersect. Since the response of the recording instrument is minimum at the edges of the field of view, with a decrease in the mass of meteor bodies the effective collecting area decreases and becomes equal to zero for a threshold mass. If a linear segment is obtained in the integral mass distribution of meteor bodies it can be assumed that all meteor bodies whose mass exceeds the minimum mass on the linear segment are registered and the effective collecting area for these meteors is constant. It is assumed that for sporadic meteors the exponent s remains constant or changes insignificantly in the entire range of meteor velocities. The mean density of the incident stream is determined, as a result of which it becomes possible to use the mean values of the characteristic parameters determined from observations. Radar observations made of trails of sporadic meteors with a duration of 0.1 s or more (masses $m \geq 1.4 \cdot 10^{-3}$ g were processed using these procedures and assumptions. In 6,800 hours of observations a total of 226,000 such meteors were registered. With allowance for the density distribution of meteor bodies, with a duration greater than 10 s and with allowance for the attachment of electrons to neutral particles in meteor trails, it was found that for the mass range from 10^{-3} to 10^{2} g the exponent s = 2.1. Specific results are given for other series of observations. The results of determinations of the mean density of the stream of sporadic meteors incident on the earth as a function of their mass are presented. The results agree well with data published by D. W. Hughes (PLANET AND SPACE SCI., Vol 20, No 11, pp 1949-1959, 1972). Figures 1; references 6: 1 Russian, 5 Western.
[23-5303]

UDC 629.78.015.076.6:521.4

ONE CASE OF DETERMINATION OF ELEMENTS OF INTERMEDIATE ORBIT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 2, Mar-Apr 85 (manuscript received 20 Feb 84) pp 308-310

LUKASHEVICH, Ye. L.

[Abstract] The author describes a procedure for determining the elements of an intermediate orbit constructed earlier (Ye. L. Lukashevich, KOSMICH. ISSLED., Vol 21, No 4, p 634, 1983) on the basis of rectangular geocentric equatorial coordinates $x = x_0$, $y = y_0$, $z = z_0$ and their derivatives $\dot{x} = \dot{x}_0$, $\dot{y} = \dot{y}_0$, $\dot{z} = \dot{z}_0$, known at the moment in the time $t = t_0$. The procedure makes it possible to take into account all perturbations from the second zonal harmonic of geopotential and also secular perturbations and in part periodic perturbations from an arbitrary even zonal harmonic of the order 2n

from a set of potential terms remaining not taken into account in the force function of a symmetric variant of the generalized problem of two fixed centers. The expressions derived in the earlier study for computing the ξ, η, w coordinates at an arbitrary moment t in time are dependent on the orbital elements a, e, s, ω, Ω, M_0, corresponding to the semimajor axis, eccentricity, sine of the angle of inclination, argument of pericenter, longitude of the ascending node and the mean anomaly for the epoch t_0 of a Keplerian orbit. On this basis the problem of determining the orbital elements is solved in the same sequence as the similar procedure within the framework of the generalized problem of two fixed centers: finding the spheroidal coordinates ξ_0, η_0, w_0 and their derivatives $\dot{\xi}_0$, $\dot{\eta}_0$, $\dot{w}_0$; computation of the constants α_1, α_2, α_3; determination of nonangular elements a, e, s; determination of angular elements ω, Ω, M_0. The article discusses the second and third of these steps. References: 2 Russian.
[93-5303]

UDC 629.783

ANALYTICAL EVALUATIONS OF ACCURACY IN DETERMINING AND PREDICTING PARAMETERS OF ARTIFICIAL EARTH SATELLITE MOTION USING ALTIMETER MEASUREMENT DATA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 2, Mar-Apr 85 (manuscript received 7 Feb 83) pp 310-314

NEVOLKO, M. P. and MOSIN, Ye. L.

[Abstract] The proposed analytical evaluation of accuracy in determining and predicting orbits is based on a method described by L. F. Porfiryev, et al. (KOSMICH. ISSLED., Vol 6, No 3, p 352, 1968) and S. I. Bychkov, et al. (KOSMICH. ISSLED., Vol 10, No 4, p 620, 1972). In the statistical processing of measurements use is made of an A matrix of the partial derivatives of the measured parameter (flight altitude) and an m-dimensional vector C and the elements of a B matrix of normal equations (the elements of the A matrix must be first determined as a function of time t). Evaluations are made on the assumption that the artificial satellite moves in a central gravity field and that the satellite motion deviates little from a circular orbit of the radius r_0 (in an unperturbed orbit). In evaluating the accuracy in determining and predicting satellite motion on the basis of altimeter measurements use is made of a cylindrical coordinate system r, u, z, where r is the geocentric distance of projection of the satellite onto the plane of the unperturbed orbit; u is the polar angle in the plane of the unperturbed orbit; z is the distance from the plane of the unperturbed orbit to the satellite. With these assumptions and the selected coordinate system it is possible to determine in analytical form the elements of the matrix of derivatives of the measured parameter for any position of the satellite in orbit. Then it is easy to find analytical expressions for evaluating the accuracy in determining spacecraft motion using altimeter data. It was found that the principal contribution to the error in predicting satellite motion (with respect to both the radius-vector and along the orbit) is introduced by change in atmospheric density. Figures 1; tables 1; references: 5 Russian.
[93-5303]

UDC 551.521.8

DIRECTIVITY OF PROTON FLUX WITH E_p>12 KeV IN LOW-LATITUDE TRANSITION REGION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 2, Mar-Apr 85
(manuscript received 16 Nov 83) pp 317-319

KUDELA, K., LUTSENKO, V. N., PISARENKO, N. F., ROYKO, Y. and FISHER, S.

[Abstract] It is important to study the characteristics of fluxes of energetic charged particles near the magnetopause and in the transition region in order to understand magnetic field topology in these regions. New data along these lines were obtained with the ISEE satellites: on energetic protons with energies E_p>25 KeV and electrons with E_e>20 KeV. The distributions of particle fluxes indicated the presence of open lines of force in the low-latitude region near the magnetopause within the magnetosphere in the region ~1030 LT. This article gives data on proton fluxes in the low-latitude transition region for lower energies, E_p>12 KeV. The measurements were made on the "Prognoz-8," launched into a high-apogee orbit on 25 December 1980. A study was made of the behavior of energetic particles using the Soviet-Czech DOK-T instrument, designed for studying the possibilities of use of passive cooling of semiconductor sensors in preamplifiers for reducing noise. During the entire experiment it was possible to register low-energy electrons and protons (E_e>9 KeV, E_p>12 KeV) with a sufficiently high geometry factor for this energy range. The article gives data only for protons. Supplemented by data from another plasma experiment, cases of passage through the transition region were selected when the proton flux was much greater than the electron flux. Two types of angular distributions were found. Four low-latitude passages of the "Prognoz-8" through the transition region near the plane of the midday meridian in unperturbed time revealed the following. The distribution of the fluxes of protons of the mentioned energies in the transition region in most cases has the nature of narrow one- or two-directional beams along the line of force or antiparallel to it. The main direction of the proton flux was from the magnetopause into the transition region. Collimated fluxes are observed when there is an increase in the intensity of particles in the transition region or in the boundary layer. A bidirectionality of the proton fluxes observed with low $|B|$ values along most of the trajectory during passage through the transition region is a characteristic property of proton fluxes. A decrease in the threshold of registry of particles to ~10 KeV with an adequate geometry factor makes it possible to obtain data which can lead to a considerable refinement of the picture of distribution of fluxes of particles of intermediate energies in the transition region. Figures 3; references 6: 1 Russian, 5 Western.
[93-5303]

UDC 629.015+531.38

EVOLUTION OF ALMOST CIRCULAR ORBITS OF 12-HOUR ARTIFICIAL EARTH SATELLITES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 1, Jan-Feb 85 (manuscript received 9 Jun 83) pp 3-15

VASHKOVYAK, M. A.

[Abstract] The motion of a 12-hour artificial earth satellite (AES) has a number of specific features caused by the commensurability of its mean motion and the angular velocity of the earth's rotation (resonance 2:1). In unperturbed Keplerian motion this commensurability leads to a repetition of the trajectory on the earth's surface each two satellite revolutions. The article gives an analysis of evolution of almost circular orbits of 12-hour AES under the influence of the principal perturbations in a time interval of several years. The basis for this analysis was the equations used in the numerical-analytical method developed earlier by the author (KOSMICH. ISSLED., Vol 21, No 6, p 819, 1983). This procedure excludes short-period changes in orbital elements which are unimportant for an approximate study, but the main secular and long-period perturbations are retained. This makes it possible to derive approximate formulas describing secular and long-period perturbations of orbital elements under the influence of attraction of the moon, sun, light pressure force and noncentrality of the earth's gravity field. The fundamental qualitative and quantitative characteristics of evolution are confirmed by comparison with the results of computations made by the numerical-analytical method for a time interval of 1,000 days. Figures 7; references: 6 Russian.
[90-5303]

UDC 521.15

COMPARISON OF CONDITIONALLY PERIODIC SOLUTIONS WITH RESULTS OF NUMERICAL INTEGRATION IN PROBLEM OF TRANSLATIONAL-ROTATIONAL SATELLITE MOTION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 1, Jan-Feb 85 (manuscript received 5 May 83) pp 16-25

ZLENKO, A. A.

[Abstract] In an earlier article (KOSMICH. ISSLED., Vol 22, No 4, 1984) the author used the S. G. Zhuravlev method (CELEST. MECH., Vol 19, No 1, p 77, 1979; Vol 25, No 3, p 297, 1981; Vol 27, No 2, p 179, 1982) in obtaining conditionally periodic solutions in the problem of translational-rotational motion of an axisymmetric satellite. In the present article the author checks the effectiveness of this method in the considered problem in astrodynamics and determines the suitability of these conditionally periodic solutions for describing satellite motion. This is done by numerical integration of the precise equations of motion and a comparison

of the results with the results of computations by analytical formulas. Emphasis is on one special case of motion of the center of mass of a satellite in a circular equatorial orbit. It was found that conditionally periodic solutions even in the first approximation give good agreement with numerical integration in a relatively short time interval. The qualitative picture of the solutions did not change; there were only quantitative changes. In order to have good agreement over a longer time interval it is necessary that stationary solutions be obtained as precisely as possible and that the initial values of the integration variables be found (the next approximations of conditionally periodic solutions be obtained). The derived formulas for conditionally periodic solutions can be used in planning the orbits of resonance satellites and finding the amplitudes and periods of short-period oscillations for control and stabilization purposes and also for a rapid evaluation of the qualitative and quantitative picture of motion. This makes it possible to reduce time expenditures by an order of magnitude in comparison with numerical integration. Figures 3; references 7: 3 Russian, 4 Western.
[90-5303]

UDC 629.7.4.631.82

'OBLIQUE' REGULAR SATELLITE MOTIONS AND SOME FINE EFFECTS IN MOTION OF MOON AND PHOBOS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 1, Jan-Feb 85 (manuscript received 16 Feb 82) pp 26-36

BARKIN, Yu. V.

[Abstract] It is demonstrated that the unrestricted problem of satellite motion allows solutions which correspond to positions of relative equilibrium different from Lagrangian. Specifically, there can be "oblique" positions of a satellite in a circular orbit for which its main central axes of inertia do not coincide with the axes of the orbital coordinate system, although they are close to the latter. Another peculiarity of these solutions is that the corresponding circular motion of the satellite center of mass occurs in a plane not containing the center of the attracting body. It is assumed that the satellite has an arbitrary dynamic structure, but a restriction is introduced, it being postulated that its dimensions are quite small in comparison with the distance to the central body. It is shown that the angular and linear displacements of the satellite axes of inertia are attributable to the influence of the third and higher harmonics of the problem force function. The solutions which were found made it possible to explain the observable constant angular displacements of the lunar axes of inertia and to predict similar effects in the motion of Phobos and also to predict finer effects in the motions of these bodies (dynamic constant displacements of their centers of mass). In order to calrify the nature of these solutions, in addition to the unrestricted satellite motion problem, the author examines the restricted problem of satellite motion in a circular

orbit in which the third harmonic of the force function is taken into account. It is shown that this restricted problem also allows "oblique" positions of equilibrium. Tables 2; references 14: 9 Russian, 5 Western.
[90-5303]

UDC 629.76.015

SYNTHESIS OF OPTIMUM TRAJECTORIES FOR ORBITAL INSERTION FROM ANY POINT OF WHICH DESCENT INTO ATMOSPHERE IS POSSIBLE WITH STIPULATED RESTRICTIONS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 1, Jan-Feb 85 (manuscript received 1 Apr 83) pp 37-48

ILIN, V. A. and FILATYEV, A. S.

[Abstract] Solution of a number of problems requires study of a class of branching trajectories containing a continuum of branches adjacent to the main branch, not a discrete set. An example is a trajectory in which a vehicle is put into orbit, from any point of which the return of a descent module is possible without violation of the restrictions imposed on the descent segment. This article is devoted to examination of a method for the optimization of such a class of branching trajectories. A special feature of the proposed formulation is that an analysis is made of branching trajectories with an infinite number of branches at whose internal points restrictions are imposed on the phase variables. A solution of this problem is obtained by replacement of the phase limitations on the descent trajectory by equivalent restrictions on thrust vector orientation at a stipulated point on the trajectory. The basis for this replacement is an approximate analytical representation of the influence of a change in the current phase vector on the maximum dynamic and thermal loads during descent module entry into the dense layers of the atmosphere. The model problem of optimization of a launching trajectory from any point of which a descent module can return with satisfaction of a stipulated restriction on the velocity head is examined. Allowance for this restriction results in a considerable modification of the optimum launching trajectory without a significant worsening of the minimizing functional. This modification also results in a relatively small (several percent) reduction of payload mass put into orbit. Figures 6; references 10: 8 Russian, 2 Western.
[90-5303]

UDC 629.78

APPLICATION OF RELATIVISTIC THEORY TO PROBLEMS OF SPACE VEHICLE TRAJECTORY MEASUREMENTS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 1, Jan-Feb 85 (manuscript received 9 Feb 83) pp 49-62

CHAPLINSKIY, V. S.

[Abstract] Initial expressions are derived clarifying the relationships between the parameters of electromagnetic signals in the reference systems employed in space vehicle trajectory measurements, as well as fundamental expressions for determining navigational functions which take into account the relativistic transformations of signals in circumterrestrial space with an accuracy adequate for practical purposes. The navigational parameters are determined from measurements of signal frequency and phase. The following aspects of this problem are examined: measurements of pseudorange and radial pseudovelocity of space vehicle; measurements of differences in pseudoranges and differences in radial pseudovelocities of space vehicle relative to spaced measurement points; measurement of total pseudorange and total radial pseudovelocity of space vehicle relative to spaced points; measurement of difference in pseudoranges and difference in radial pseudoranges of two space vehicles. It is shown that the relativistic transformations of electromagnetic signals are manifested most clearly in noninterrogation regimes of trajectory measurements. In these regimes the influence of relativistic effects considerably exceeds possible measurement errors. The use of the derived expressions for the determination of navigational parameters on the basis of direct and total-difference frequency-phase measurements ensures the retention of instrumental accuracy of direct measurements. The requirements on the accuracy of a priori data on the motion of a spacecraft used in computing the relativistic corrections are entirely realizable. References: 4 Russian.
[90-5303]

UDC 537.525.1

STABILITY OF DIAMAGNETIC PLASMOID IN MAGNETOSPHERE

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 1, Jan-Feb 85 (manuscript received 1 Apr 83) pp 100-105

LEONTYEV, S. V., LYATSKIY, V. B. and KHRUSHCHINSKIY, A. A.

[Abstract] In an earlier article (GEOMAGNETIZM I AERONOMIYA, Vol 23, No 6, p 963) the authors examined plasmoids (blobs) of hot particles moving in an external magnetic field filled with cold plasma and maintained in equilibrium by their own diamagnetism. In this new article it is shown, however, that the blobs of particles postulated earlier can exist over a

time substantially exceeding the bounce period of the particles. The possible existence of such stable blobs of particles in the magnetosphere is also of interest with respect to experiments with the artificial injection of accelerated particles into the magnetosphere. The earlier article examined the stability of a diamagnetic blob in a uniform magnetic field oscillating between two ideally reflecting oscillating "mirrors." This article examines a more realistic situation when the diamagnetic blob oscillates in a nonuniform magnetic trap. The study revealed that in the case of a nonuniform field more rigorous limitations are imposed on the parameters of motion of blob particles than in the case of a uniform field. The range of velocities admissible for stability conditions is narrowed and limitations are imposed on both longitudinal and transverse velocities. The limits of regions of capture of particles by a blob oscillating along the magnetic lines of force were computed by numerical integration of the equations of motion. The region of capture is broadened with an increase in the intensity of the magnetic disturbance generated by the blob. In order to generate an artificial stable diamagnetic blob in the magnetosphere it is necessary to inject fluxes of accelerated particles sufficiently strong to cause appreciable magnetic field disturbance. In artificial injection the accelerated particles must be directed at a considerable angle to the magnetic field. Under natural conditions a particle is accelerated in regions where there is a longitudinal potential difference, such as over an auroral arc. Figures 3; references 6: 3 Russian, 3 Western.
[90-5303]

UDC 581.521

ENERGY DISTRIBUTIONS OF PROTONS WITH $0.05 \leqslant E \leqslant 50$ MeV IN EARTH'S RADIATION BELTS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 1, Jan-Feb 85 (manuscript received 7 Feb 83) pp 106-112

PANASYUK, M. I. and SOSNOVETS, E. N.

[Abstract] The energy distributions of protons in a wide range of energies ($0.05 \leqslant E \leqslant 50$ MeV) in both the outer and inner radiation belts are given on the basis of the results of experiments on the "Molniya-2" artificial satellite carried out in 1974. These are compared with the results of measurements of quasiperiodic geomagnetic field fluctuations in the low-frequency range which might be the mechanism of formation of the additional maximum in the spectrum and the increase in the diffusion coefficient observed in the inner radiation belt. The data analyzed were taken from an ascending segment of an orbital revolution during a magnetically quiet time in October 1974. The analysis revealed that there are two different mechanisms operative in formation of the maximum in the spectra. Whereas in the outer radiation belt the formation of the maximum in the energy range of hundreds of keV is attributable to operation of loss mechanisms (charge exchange and Coulomb collisions) in the process of

transport of protons to the earth, in the inner belt the most probable mechanism of formation of the maximum with an energy of several MeV is of a resonance nature, under the influence of quasiperiodic geomagnetic field variations. These fluctuations, together with the dominance of low-frequency Pc-3-Pc-4 waves in the magnetosphere, are the most probable agents responsible for the observed increase in the diffusion coefficient for radiation belt high-energy protons. Figures 2; references 20: 6 Russian, 14 Western.
[90-5303]

UDC 551.521

DYNAMICS AND PREDICTION OF RADIATION CHARACTERISTICS OF SOLAR COSMIC RAYS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 1, Jan-Feb 85 (manuscript received 26 Aug 83) pp 123-133

BENGIN, V. V., MIROSHNICHENKO, L. I. and PETROV, V. M.

[Abstract] In order to ensure radiation safety it is important not only to obtain an estimate of the anticipated flux of solar cosmic rays (SCR) $F(\varepsilon_c)$ with a given energy ε_c, but also to predict the development of a solar proton event (SPE), the spatial-temporal change in the intensity $I(\varepsilon_c) = F/4_\pi$ and the energy spectrum of SCR. In predicting the radiation level effect from each SPE the accuracy and reliability of the predicted $F(\varepsilon_c)$ values must be evaluated in order to take more reliable protective measures for decreasing the level of cosmonaut irradiation. However, no method has yet been developed which meets all the requirements on such prediction or which fully corresponds to the physical nature of the processes of generation and propagation of SCR, especially the probabilistic nature of the dynamics of SCR streams as a process subject to the influence of random factors. Accordingly, the authors have proposed a probabilistic method for predicting the radiation characteristics of SCR on the basis of a priori information on the parameters of solar proton events (SPE). Attention is given to a mathematical prediction model (algorithm), choice and comparison of SPE models, determination of distribution functions for different SPE parameters, and testing of a full model for predicting dynamics of SPE. The applicability and effectiveness of the method is adequate for predicting the dynamics of SCR streams. Finally, the prospects for improving the probabilistic method are discussed, taking into account a priori data on the spectrum and physical limitations on the parameters of SCR propagation. Figures 5; references 18: 10 Russian, 8 Western.
[90-5303]

UDC 523.72

INTERPLANETARY DISTURBANCE FROM FLARE TRIPLET IN MAY 1981 AS OBSERVED BY 'PROGNOZ-8'

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian, Vol 23, No 1, Jan-Feb 85 (manuscript received 5 May 83) pp 134-142

ZASTENKER, G. N., BORODKOVA, N. L., IVANOV, K. G. and MIKERINA, N. V.

[Abstract] A study was made of an interplanetary disturbance observed after a series of powerful solar flares occurring in an active region near the earth's helioprojection during the period 4-9 May 1981 in STIP Interval XII. Several phenomena are observed near the earth in connection with such multiple events. There is a shock wave deficit with shock waves either being absent or greatly weakened and occurring in a lesser number than the flares; in addition, there is a diffusion front--a monotonic increase in the mean level of proton concentration to very high values. However, this class of disturbances has been poorly studied. The following phenomena were observed in the interplanetary magnetohydrodynamic disturbance as revealed by detailed measurements of plasma and the magnetic field by "Prognoz-8" and magnetic measurements by ISEE-3 (as in other disturbances from series of flares in a single region occurring within a short time interval). There was a complete absence of strong, fast magnetosonic shock waves; there was a region with a multihour, almost monotonic increase in the concentration of protons; there was a dropoff of the temperature of α-particles to the temperature of protons and a prolonged state with $T_\alpha \approx T_p$. The registry of radio bursts types II and IV in the corona indicates escape of shock waves from the corona into interplanetary space and therefore the above-mentioned phenomena are evidently a consequence of the postulated strong attenuation of shock waves from individual triplet flares during their interaction with one another. Figures 4; tables 3; references 24: 11 Russian, 13 Western.
[90-5303]

UDC 551.510.53

O^+-He AND H^+-He MEAN COLLISION FREQUENCIES FOR IONOSPHERIC RESEARCH

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 1, Jan-Feb 85 (manuscript received 10 May 82) pp 143-147

PAVLOV, A. V.

[Abstract] A model of polarization dipole interaction is used in computing mean collision frequencies with the transfer of momentum ν_{in} for nonresonance interactions between ions and neutral particles. In particular, it is demonstrated that in planetary ionospheres the ν_{in} values for O^+-He

and H^+-He must be computed in an approximation of a more real potential (12, 6, 4). An approximation of reduced collision integrals entering into ν_{in} is proposed for typical atmospheric reduced temperature values, thereby making it possible to derive an analytical expression for ν_{in}. In comparison with more precise ν_{in} values in the potential approximation (12, 6, 4), the use of the generally accepted expressions for ν_{in} in the upper atmospheres of the planets leads to the following errors: 8-23% for H^+-He and 20-50% for O^+-He. These findings are especially important in modeling the Venusian atmosphere. Specifically, the use of expression (9), derived in this article, is recommended in computing ν_{in} for H^+-He, O^+-He, whereas expression (5) is advocated for the interaction of ions with other neutral components. It is emphasized that only nonresonance interactions are considered here. Tables 1; references 18: 7 Russian, 11 Western.
[90-5303]

UDC 550.388

NUMERICAL MODELING OF INTERACTION BETWEEN SOLAR WIND AND COMETARY PLASMA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 1, Jan-Feb 85 (manuscript received 28 Apr 84) pp 158-166

LIPATOV, A. S.

[Abstract] The dynamics of the magnetic field and interaction between the solar wind and heavy cometary ions were investigated using a collisionless method. Since the gyroradius of heavy cometary ions, computed on the basis of the velocity and magnetic of the solar wind, can be $\sim 10^4$ km, in the neighborhood of the shock wave and the contact surface the equations of hydrodynamics are no longer valid. Moreover, in the acceleration process the cometary ions acquire an energy considerably exceeding the energy of solar wind protons, resulting in a two-phase flow of the solar wind and cometary plasma with different thermodynamic parameters. In order to clarify this problem the author investigated the flow structure in the cometary coma, taking into account the effects of the finite Larmor radius of solar wind protons and cometary ions. Numerical modeling revealed that with propagation of a solar wind flow through the region near a comet the ionized component of cometary matter is entrained, resulting in formation of a flow of cometary ions with a characteristic temperature $M_c W_\infty^2/2$ considerably exceeding the temperature across the magnetic field $M_p W_\infty^2/2M_c^2$ and the retarding temperature of protons $M_p W_\infty^2/2$. At the "frontal" part of the cometary coma, due to the grat Larmor radius of ions, the mean velo ity of ions differs appreciably from the mean velocity of protons. A special property of a comet is the presence of high-energy ions at the shock wave front. The thickness of the shock wave front and the structure of the transition region have a characteristic scale determined by the Larmor radius of heavy ions. Figures 5; references 22: 10 Russian, 12 Western.
[90-5303]

UDC 522.1:523.14

USE OF DIFFERENTIAL VERY LONG BASELINE RADIOINTERFEROMETRY IN ASTRONAVIGATION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 1, Jan-Feb 85 (manuscript received 22 Jul 83) pp 167-174

KOGAN, L. R., MATVEYENKO, L. I. and KOSTENKO, V. I.

[Abstract] Requirements on instrumentation, accuracy in knowledge of interferometer bases, reference objects and methods for measuring the coordinates of space vehicles by the very long baseline radiointerferometry (VLBR) method are reviewed. All this is applied to the problem of determining the coordinates of a space vehicle during its approach to Halley's comet when using the Soviet VLBR network. A figure shows the trajectory of vehicle motion in an equatorial coordinate system, also showing the nearest quasars (the parameters of the latter are given in Table 1), since the trajectory will pass near five quasars prior to rendezvous with the comet. It is proposed that the Simeiz-Yevpatoriya-Pushchino radiointerferometer be used, supplemented by the 64 meter radiotelescope at Medvezh'i Ozera and radiotelescopes in the Asiatic USSR (the parameters of all these radiotelescopes are given in Table 2). Table 3 gives the results of computations of the possible performance of this network; the data in this table are used in proposing a scheme for measuring space vehicle coordinates in the Soviet VLBR network. It is shown that the VLBR method makes it possible to determine vehicle coordinates with a high accuracy. The accuracy in determining relative coordinates can be as high as fractions of a millisecond of arc. A quasar or the space vehicle itself can be used as the reference source. The accuracy of absolute measurements of vehicle coordinates, with errors in quasar coordinates taken into account, can attain tens of milliseconds of arc. In determining the absolute coordinates of the European vehicle launched to Halley's comet it is possible to use the results of measurements of the absolute coordinates of a vehicle approaching the comet two weeks earlier. Figures 2; tables 3; references 9: 4 Russian, 5 Western.
[90-5303]

UDC 528.2:629.78

NUMERICAL INVESTIGATIONS OF RESONANCE INEQUALITIES OF LOW ORBIT ARTIFICIAL EARTH SATELLITES

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOS"YEMKA in Russian No 5, Sep-Oct 84 (manuscript received 3 May 83) pp 53-57

TRAVIN, V. L., engineer, and YASHKIN, S. N., docent, candidate of technical sciences, Moscow Order of Lenin Institute of Geodetic, Aerial Mapping and Cartographic Engineers

[Abstract] This is a continuation of an earlier article by S. N. Yashkin entitled "Qualitative Investigations of an Ideal Resonance Problem" in IZV. VUZov: GEODEZIYA I AEROFOTOS"YEMKA, No 3, pp 57-63, 1983. The objective of the article is a study of the behavior of an expression for the resonance Hamiltonian derived in the earlier article, in this case in the neighborhood of a point of critical resonance, and construction of isolines of equal values of the Hamiltonian. The problem is applicable to satellites with different inclinations, eccentricities and commensurabilities. Numerical results are given for a set of model orbits and commensurabilities. It is shown that the width of the libration zone is dependent on orbital inclination. For a stationary satellite (commensurability 1/1) it is weakest, but with approach to the earth the dependence is strengthened, narrowing the libration zone for near-circular orbits to several meters. However, the dependence of the width of the libration zone for all commensurabilities of the eccentricity axis is weak. The width of the libration zone is directly proportional to the coefficient of the harmonic J_{nm}. There is no well-expressed difference between the even and odd sectorial harmonics. However, the width of the libration zone in regions with even denominators of commensurabilities is an order of magnitude less than the width of the libration zone in regions with odd denominators. Tables 1; references 4: 3 Russian, 1 Western.
[49-5303]

UDC 528.225 521.6

DETERMINING SATELLITE ORBIT FROM TWO VELOCITY VECTORS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOS"YEMKA in Russian No 5, Sep-Oct 84 (manuscript received 10 May 83) pp 57-61

ONKOV, I. V., candidate of technical sciences, Perm Polytechnic Institute

[Abstract] Due to the development of Doppler systems for the tracking of satellites it is necessary to formulate and solve boundary value problems containing the components of the velocity vector in the boundary conditions in addition to the components of its radius vector. This article gives a solution of the problem of determining a satellite orbit solely on the basis

of measurements of the components of its velocity vector because in this case there is no need for a knowledge of the precise coordinates of observation stations. In an earlier article (IZV. VUZov: GEODEZIYA I AEROFOTOS"YEMKA, No 2, pp 49-55, 1984) the author examined two methods for solving this problem using three satellite velocity vectors without using the dynamic properties of satellite motion. Proceeding on the basis of this earlier work, a method is proposed for determining the Keplerian orbit of an artificial satellite on the basis of two velocity vectors stipulated at known moments in time which is based on a Newtonian iteration process. The general idea of the method and its algorithm are presented and a numerical example is cited. This algorithm for computing satellite orbital elements on the basis of two velocity vectors is simple in its structure and is characterized by a high rate of convergence of the iteration process. Figures 1; references: 3 Russian.
[49-5303]

UDC 550.338.2

USE OF DOPPLER EFFECT IN DETERMINING ANGULAR COORDINATES OF ARTIFICIAL EARTH SATELLITE

Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR: SERIYA FIZIKO-TEKHNICHESKIKH, KHIMICHESKIKH I GEOLOGICHESKIKH NAUK in Russian No 2, Mar-Apr 85 pp 31-35

DURDYYEV, R. and IBRAYIMOV, A.

[Abstract] Ionospheric research using artificial earth satellite signals is increasingly experiencing a shortage of information on the time correspondence of observations to direction in space. In some cases existing programs make it possible to establish this correspondence, but a great number of input parameters is required and the need for their frequent correction limits their use. In this article the authors demonstrate that the use of the Doppler effect for determining the angular coordinates of artificial earth satellites makes it possible to determine this correspondence with a quite high accuracy by a simple and easily used method. A definite algorithm is proposed for this purpose. The proposed method also makes it possible to predict the time of entry of a satellite into the zone of radiovisibility with a sufficiently high accuracy and on the basis of such predictions choose the most informative satellite in the case of simultaneous presence of several satellites in the radiovisibility zone. Particular attention is given to the time referencing of observations made in space. The determination of data related to the parameters of satellite motion and angular coordinates relative to the observation point can be used not only in ionospheric research, but can also serve as a basis for automating observations. Figures 3; references: 2 Russian.
[121-5303]

UDC 681.3.016

MODELING CHARGED PARTICLE FLUXES ALONG SPACE VEHICLE FLIGHT TRAJECTORIES IN EARTH'S RADIATION BELTS

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3: FIZIKA, ASTRONOMIYA in Russian Vol 26, No 1, Jan-Feb 85 (manuscript received 28 Sep 83) pp 3-8

SAVUN, O. I. and YUSHKOV, B. Yu., Nuclear Physics Scientific Research Institute

[Abstract] The problem of modeling charged particle fluxes along the flight trajectories of space vehicles in the earth's radiation belts can be solved most simply by formulating a numerical model of the distribution of charged particles in circumterrestrial space and corresponding computer programs making it possible to obtain the instantaneous and integral values for fluxes of charged particles and their spectra along any stipulated flight trajectory. In the entire program the factor of decisive importance is the choice of the initial mass of data on particle fluxes. These data must include intensities averaged by pitch angles and relating to geomagnetic conditions and local time. Only with such simplifications is it possible to obtain a uniform mass of data covering virtually the entire range of possible L, B values. The fundamental algorithms and structure of the data banks are identical for protons and electrons. A formula must be used to take into account effects associated with the 11-year solar activity cycle. Analytical representations of the integral spectra of protons and electrons are used in such a program for computing the absorbed radiation doses. The problem essentially involves determination of the differential spectrum $y_x(E_x)$ for a given shielding X and numerical integration of an expression in the form

$$D_x = kt \int_{E_1}^{E_2} y_x(E_x) S(E_x) dE_x,$$

where D_x is the absorbed dose behind the shielding X, $S(E_x)$ are the specific energy losses in the absorbing medium, k is a factor for conversion from flux to dose, t is irradiation time. Accuracy in determining fluxes, spectra and doses are dependent on accuracy of initial data, inaccuracies in determining trajectory and L, B coordinates, discreteness in computations along the orbit and limitation of computation time to one day. The sequence of computations is: computation of satellite trajectory using initial satellite orbital parameters; computation of L, B coordinates with an appropriate interval for orbital points; interpolation of intensities from the initial data to the computed values of L, B coordinates; determination of parameters for approximating integral spectra of protons and electrons; use of the spectra for computing radiation for different shielding thicknesses. A block diagram of the computation program is given. An example of the computation method and its application is given. Figures 2; tables 1; references 7: 4 Russian, 3 Western.
[112-5303]

UDC 521.9

INTERPRETATION OF NONPOLAR LATITUDE VARIATIONS

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 11, No 1, Jan 85 (manuscript received 16 May 84) pp 78-80

KORSUN', A. A., Main Astronomical Observatory, Ukrainian Academy of Sciences, Goloseyevo

[Abstract] All latitude variations not dependent on motion of the pole are called nonpolar latitude variations or the z-term. An evaluation of changes in the z-term caused by nontidal variations of the earth's level surface is given. These nonpolar latitude variations are represented in the form of the sum

$$z(t) = \Delta\delta_k + \Delta\mu_k + A_k(t) + \Delta\gamma_{pl}(t) + \xi(t),$$

where $\Delta\delta_k$ are the errors in star declinations; $\Delta\mu_k$ are the errors in the proper motions of stars; $A_k(t)$ is a component in the errors of star declinations caused by imperfection in the theory of rotation of the earth and errors in the adopted values of a number of physical constants; $\Delta\gamma_{pl}(t)$ are local changes in plumb line direction, the greatest contribution to which is from earth tides (an estimate is given for nontidal changes in plumb line direction); $\xi(t)$ are observation errors. After excluding the influence of errors in declinations and proper motions of stars from the nonpolar latitude variations, these variations are represented as a function of change in the earth's level surface. Estimates of variations of the z-term are given. The influence of such a factor as the redistribution of air masses on the z-term is very small and beyond the limits of accuracy in modern astronomical determinations. Figures 1; references: 1 Western. [85-5303]

UDC 523.164.32

POSSIBILITY OF PARAMETRIC APPROACH TO STUDY ON PREFLARE PHENOMENA IN SOLAR PLASMA BY ANALYSIS OF SOLAR RADIO EMISSION FLUCTUATIONS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 28, No 1, Jan 85 (manuscript received 25 Nov 83) pp 3-10

AVERYANIKHINA, Ye. A., KOBRIN, M. M. (deceased) and ORLOV, I. Ya., Radio Physics Scientific Research Institute

[Abstract] Since one of the most important problems in studies of the physics of active regions on the sun is an investigation of preflare processes in solar plasma, the authors examined some additional possibilities for obtaining information on processes in active regions by regarding them as plasma parametric systems. An analysis was made of fluctuations of

preflare solar radio emission, including the nature of changes in amplitudes, energy spectra and probability distribution functions. Data were used on integral solar radio emission at a frequency of 755 MHz made at the Radioastrophysical Observatory, Latvian Academy of Sciences, using the RT-10 radio telescope from June through August 1979-1980, a period of the solar maximum. About 40 observations were selected, during which 12 powerful radiobursts associated with proton flares were observed. The pertinent parameters were analyzed before and after flares. A comparison of the results of observation of these fluctuations and the results of modeling indicated a modulation-multiplicative nature of the interaction between noise radiation and quasiperiodic processes on the sun. It is concluded that the agreement of the dynamic effects of the probability density function obtained from the results of observations in the preflare period and the results of analog and mathematical modeling, as well as comparison of experimental studies of parametric systems, give a sound basis for regarding solar activity processes as processes in a parametric system. This finding will be useful in physical interpretation of preflare phenomena and in predicting solar activity. Figures 4; references 11: 7 Russian, 4 Western.
[83-5303]

UDC 612.014

EVALUATIONS OF EXTREMAL VALUES OF INTEGRAL PROTON FLUXES IN FLARES IN PLANNING OF SPACE FLIGHTS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 2, Mar-Apr 85 (manuscript received 26 Aug 83) pp 315-316

KOLOMENSKIY, A. V.

[Abstract] There is a need for making allowance for particularly strong flares which possibly have never been observed before but whose occurrence is possible in order to evaluate the radiation safety of crews of spacecraft and in the planning of space experiments. Providing that the characteristics of distributions of flare parameters are known, the problem can be solved on the basis of the theory of extremal values of random events. Earlier the author analyzed 123 powerful flares for the period 1956-1978 during which high-energy protons were generated and estimated the distributions of proton fluxes in the energy range above 30 MeV in the time interval between flares. On the basis of this work and other data the author determined the probability of the proton flux exceeding certain extreme values for 1 and 2 years. An analytical expression was derived for the dependence of the probability of appearance of great flares on flight duration. Using the significance level 0.05, as is usually employed, the extremal characteristics for proton fluxes for 1 and 2 years were calculated to be $2 \cdot 10^9$ and $4 \cdot 10^9$ protons/cm^2 respectively. Figures 1.
[93-5303]

/9835

INTERVIEW WITH KOVTUNENKO, 'VEGA' PROJECT HEAD

Moscow KRASNAYA ZVEDZDA in Russian 20 Jul 85 p 3

[Interview by Colonel M. Rebrov with "Vega" project head, Hero of Socialist Labor and laureate of Lenin and State Prizes of the USSR, Corresponding Member of the USSR Academy of Sciences V. Kovtunenko: "The Meeting Time Does Not Change"; passages in slantlines printed in boldface.]

[Text] /The automated stations "Vega-1" and "Vega-2" continue their flight along the interplanetary path. The control center tracks their movement. The information of the "present day returns us to the past. . . . I am looking at a caravelle of the space age which is standing in the "Dock" of its design bureau. It is an exact mock-up of the devices which are now in flight. All around me are people in white lab coats and variously colored plastic helmets. There is an unusualness of external outlines, an elaborate web of tubes, a labyrinth of wires, the amazing shapes of "antennas and the outstretched wings of solar panels...

The highly complex electronics that is distributed on external brackets and inside the apparatus permits the "caravelle" to see, hear and extend the invisible antennae of its radars far ahead of itself.

Vyacheslav Mikhailovich Kovtunenko was standing beside this and, it seemed to me, looking with studious curiosity at this creation of the century. Then, smiling at his own thoughts, he shook his head. Here in the design bureau, where automated explorers of the universe are produced, is where our discussion took place./

A few words by way of introduction. Vyacheslav Mikhailovich Kovtunenko started with Sergey Pavlovich Korolev then worked many years in the design bureau where Soviet-Indian satellites were created. He defended his doctoral dissertation there and became a professor, was chosen as a corresponding member of the USSR Academy of Sciences and lectured at university for many years. Later on, under his leadership, the "Astron" astrophysical laboratory was created and the last "Venera" type satellites produced.

Somewhat taller than medium height, lean and smart looking. His gaze is attentive with sparking strong eyes which are friendly and dreamy. He speaks

unhurriedly, pronouncing some of his words with emphasis. Those words which, in his opinion, reflect the most important idea. In the course of our conversation he often repeated: "Everything must be accurately calculated. We have no right to make a mistake either in major or minor things; a space experiment demands enormous expenditures and therefore the output should correspond to the efforts invested."

Where shall we begin? He looked at his watch and I - at his face, slightly tired, but open and kind.

[Question] Vyacheslav Mikhailovich, what does a designer think about when he looks at his creation?

[Answer] If you think he is admiring his work, you are mistaken. If you think that he suddenly begins to doubt whether he has chosen the best variant, you will also have to be disappointed. We solved a concrete problem, mindful of all the complexities contained therein. Some things had to be prognosticated. However, that's characteristic for everyone who is involved in the development of space technology...

[Question] From your colleagues I heard that the unusual is not only the extraordinary. It is also the ordinary, but on the bounds of the possible.

[Answer] The path to solving any serious problem, as a rule, is marked not only by successes but also by disappointments, even if they are only temporary ones. And the criteria for what is true and what is false in design decisions must be not only the strictness of the concept's foundation, but the experiment itself. Our ideas we can sometimes test only in space flight itself, in the experiment. Yet a limit to the possible really does exist.

[Question] What is it?

[Answer] First and foremost it is in the rigid confrontation between two principles, two requirements. We must reduce weight as much as possible but increase reliability many times. What's beyond this? Priority has to be given to science, filling the probe up with research equipment and force every gram of its weight and every cubic centimeter of its volume to work. I repeat, maintaining the necessary level of reliability is primary. The path to Halley's comet is not short, the probe will be in flight 15 months, about 440 days. The success of the entire experiment is determined, to a great extent, by the "hardiness" of the probe when it is bombarded by micrometeors. especially when passing by the coma - that unique cloud of plasma and gas and "star dust". Here even minuscule particles could cause a lot of trouble. Their speed is enormous, and the instruments are exceedingly sensitive. We cannot do without a protective system, yet how can we be sure of its reliability?

The problem was solved on Earth. A method of modeling was developed by the institutes of the USSR Academy of Sciences. The calculations were checked experimentally. A series of highly interesting experiments were conducted. The effect of a high-speed impact was determined with the help of special instruments, light-gas ballistic devices and laser radiation, as well as electron guns...

[Question] What measures to improve the probe's hardiness did you choose?

[Answer] Its protection was designed in the form of two-layer and three-layer screens - unique shields made of an aluminum alloy. The first layer takes the principal impact of the particle and shatters the micrometeor. The products of this microexplosion and the "fragments" of the particle are slowed by the other layers.

[Question] In the "Venus to Halley's Comet" project, in the preparation of experiments and the construction of the scientific apparatus, not only the top scientific centers of our country took part, but also scientists and specialists from Austria, Bulgaria, Hungary, East Germany, Poland, France, Czechoslovakia and West Germany. How was "compatibility" between ideas and instruments achieved?

[Answer] Cooperation broadens the opportunities for any experiment. "Two heads are better than one" is an old saying. An exchange of ideas doubles their quantity: that's provided that two are being exchanged. But if there are many?.. However, cooperation also complicates the problem. There are highly interesting ideas and the cleverest of devices, but how to combine them? The technical coordination of a project is not such a simple matter. Electromagnetic compatibility, timing programs for switching things on, thermal conditions... Here's where the technique of compromise comes into play; after long and heated discussions a final decision is made in favor of reason, rationality and optimization.

It must be said that we were extremely lucky with Halley's comet. Lucky in the sense that literally at the start of the space age we became contemporaries of the regular return of this remarkable nomad. The last meeting with the comet was in 1910, the next won't be until the 21st century. We couldn't miss this unique phenomenon. That's why we had to seek the optimal approaches for our so-called "comet communications session". We were stumped on the means by which the transmission of data would be carried directly to Earth. This forced us to increase the efficiency of our radio link by almost 20 times and to ensure constant adjustment in the orientation of the probe's antennas toward Earth during its fly-by of the comet.

[Question] Vyacheslav Mikhailovich, you passed through the fiery experience of the Great Patriotic War. Did it happen that in the breaks between battles your thoughts carried you into the cosmos?

[Answer] After tenth grade everyone stands at a crossroads: whether to join the "technicians" or the "humanitarians." My schoolmates dreamed of the sky, of the sea, of military school and of university. I was no exception. Although the war did force me to postpone my dreams until later. Victory was the main thing for us.

But about creating a flying craft capable of traveling enormous distances in space and, somewhere out there, in the black silence, seeking out a comet, approaching it and inside its coma finding a small nucleus, measuring all of a few kilometers, and conducting measurements, of course, I did not even dream. Then that was from the realm of science fiction.

A constant question: "What for?" At times it is unspoken, but it is heard. I will answer: for science, which today is inseparable from practice. It is important to us to lift slightly the veil of secrecy from the fundamental building blocks of the world's construction, from which, several billion years ago, were formed the planets (including our Earth as well) and along with them other heavenly bodies. Having gotten underneath the atmospheric cloak of the comet, to its nucleus, in which, like in a cosmic refrigerator, protoplanetary substances have been kept in primordial form, we will find out about the important thing that took place at the time our solar system was born.

[Question] The principal, critical stage of the experiment will begin a total of several days before "Vega's" meeting with the comet: at the end of February and beginning of March of next year...

[Answer] Yes, the meeting time does not change. It can only be adjusted as the approach culminates.

Two days before approaching Halley's comet, when the probe is 14 million kilometers from it, the first transmission of the work of the scientific apparatus will start: reconnaissance will be conducted, the operational status of all on-board systems will be tested, and we will orient the platform and obtain approach information. The second transmission will take place when the distance to the nucleus of Halley's comet is seven million kilometers. At the time of encounter, the third transmission will begin. That is the most crucial stage.

The distance between the probes and earth is about 170 million kilometers. A signal sent by us takes 10 minutes to reach its destination. For such complicated experiments there is not much time. That's why, together with controls from Earth, provision is made for issuing commands on the basis of the data contained in the memory of microprocessors.

Of course, that's all very complex. And we always doggedly strive to perform the most complex experiments. Not only curiosity and the eternal desire to surpass the boundaries of the possible inspire scientists and designers to carry out projects such as "Vega." For science and for man, space is a new sphere of practical activity, which promises new discoveries, new knowledge and new practical applications. We will obviously continue to work toward automated laboratories in exploring the distant cosmos.

[Question] How do you work? More precisely, what is the main feature of your work?

[Answer] Design, the choice of technological resolutions to problems is mainly the search for ideas. I don't like to introduce complications when the problem can be solved simply and clearly. At the same time we cannot start without considering all the details of how we will finish. A successfully implemented idea is the product of a collective effort.

[Question] You once said, "Project 'Vega' is the generalized destiny of a general decision." Now it actually exists and has already proven itself by carrying out a program of research on Venus. How did it all begin?

[Answer] The history of the "Vega's" creation is its own kind of a drama of ideas. It has its own subjects and its own characters. But to tell the story would take many hours. Where could we find these hours? I will say: "Vega" is the unification of the concepts, bold in their originality, of mathematicians and physicists, electricians and materials scientists, components engineers, energy engineers..." Listening to Vyacheslav Mikhailovich's story I keep returning in my thoughts to another project, one of Korolyov's, which was represented by two letters: "PS" - basic satellite. How grandiose it then seemed to us - the very concept of creating an artificial satellite for the planet of man' "Man-made moon" "Herald of the Century", "Russian Miracle"... With such ceremoniousness these words echoed in all languages of the world! Sputnik 1 looks modest now in comparison with the creations of the today. All that occurred on the 4th of October 1957 was truly a miracle, although one that has become commonplace, but nonetheless a miracle.

I also thought: not only people, but things have their destiny as well. The creation of the first satellite, the space ship "Vostok", the first lunar rockets and automated interplanetary probes have gone down in history for all time. But today as well miracles are happening. How could a flight to Halley's comet be called anything else!

From Earth to Venus to Halley's comet. Such is the concept, such the program of completed and pending research in space. After corrections were made on the 25th and 29th of June, both "Vegas" entered upon the final legs of their trip, heading for the comet. I repeat the words of the chief designer: "The meeting time does not change."

12961
CSO: 1866/123

UZBEK BUREAU DEVELOPED INSTRUMENTS FOR 'VEGA' SPACECRAFT

Tashkent PRAVDA VOSTOKA in Russian 4 Sep 85 p 3

[Excerpt] Two of the instruments on board the automatic interplanetary stations "Vega-1" and "Vega-2", which are rushing to meet Halley's Comet, were developed at the Uzbek Academy of Sciences' Central Planning, Design and Technological Bureau of Scientific Instrument Building. They are a laser counter which measures the size and structure of aerosol particles, and a phase-transition indicator which examines the particles' element composition.

Both instruments are multipurpose ones. Not only can they be used for studying planets of the solar system, they also can be employed for environmental monitoring, in which their introduction promises an economic benefit of millions of rubles.

Among other developments of the bureau's designers are an automatic instrument, the "Kristal-3", and a plotter. The quality of semiconductors is monitored with the aid of the "Kristal-3" in the manufacturing of microcircuits, transistors, diodes and other complex products.

The plotter has a number of 'specialties:' it can record graphic information, interpret results of measurements, and control several scientific experiments with the aid of a minicomputer.

(The photograph shows Candidate of Technical Sciences Ye. N. Tokarev, chief engineer of the bureau; A. V. Medvedev, head of a department; senior project designers V. M. Faynboym and L. A. Shnir; A. V. Kalyuzhnyy, head of a sector; and chief project designer N. M. Goldfeld in discussion around a table.)

FTD/SNAP/9835
CSO: 1866/38

ELECTROOPTICAL INSTRUMENT ON 'VEGA' SPACECRAFT

Kiev PRAVDA UKRAINY in Russian 19 Sep 85 p 4

[Article by T. Larina, correspondent (Lvov)]

[Excerpt] Special apparatus developed by scientists of the Ukrainian Academy of Sciences' Physical-Mechanical Institute imeni Karpenko,will be able to distinguish Halley's Comet among countless stars at a distance of 50,000 kilometers. This apparatus is installed on the Soviet space stations of the "Vega" project.

"Like pilot ships, our space pathfinders will guide the European 'Giotto' spaceships which are following them to a point from which the 'Giotto' ships will be able to come as close as possible to Halley's Comet," said Doctor of Technical Sciences P. M. Soprunyuk, deputy director of the institute. "An electrooptic system for guiding the scientific stations toward the bright nucleus of the comet will play the role of the 'helmsman' of this unique experiment."

For now, this development of the Lvov scientists, which resembles a camera with a large lens whose closed shutter cannot be penetrated by cosmic particles, is a passenger on the "Vega" spacecraft. But not an idle one, however. Signals received periodically from the stations indicate that no malfunctions in the system have been recorded in the course of operational checks in which all of the stations' instrumentation is tested.

FTD/SNAP/9835
CSO: 1866/38

UDC 523.42(048)

RESULTS ON INFRARED EXPERIMENT ON 'VENERA-15' AND 'VENERA-16'

Moscow USPEKHI FIZICHESKIKH NAUK in Russian Vol 146, No 2, Jun 85 pp 346-348

MOROZ, V. I., LINKIN, V. M. and ERTEL, D.

[Abstract] During the period October-December 1983 about 1,500 IR spectra of Venus were transmitted from the artificial satellites, "Venera-15" and "Venera-16." This experiment was carried out within the framework of the "Intercosmos" program jointly by institutes of the USSR and GDR Academies of Sciences. German specialists fabricated the Fourier spectrometer used and Russian specialists tested it, received and carried out primary processing of the information. The spectra were registered in the range 250-1600 cm^{-1}. The field of view (about 4°) made it possible to discriminate sectors with a dimension of about 60 km (near orbital pericenter) on the planet. These measurements of outgoing thermal radiation of Venus with a satellite-borne spectral instrument were made for the first time and took in latitudes from -66 to 87°. The most conspicuous detail in the spectra is the CO_2 absorption band 667 cm^{-1} (15 μm). The profile of the band 15 m was used in retrieving the dependence of temperature on altitude from approximately 60 to 90 km. The full profile of the 15-μm band was observed for the first time in the Venusian spectrum. The lines of the H_2O rotational band were also registered for the first time in the thermal emission spectrum of Venus. The band $\nu_3 SO_2$ makes a significant contribution to absorption near 1360 cm^{-1}; it had also not been observed earlier. Sulfuric acid bands can also be identified. Within the 15-μm band different parts of the spectrum are formed at different altitudes. By solving the inverse radiative transfer problem, the atmospheric temperature profile can be retrieved from each spectrum. At altitudes 70-90 km the Venusian atmosphere is systematically warmer in the high latitudes than in the low latitudes. On the daytime and nighttime sides of the planet the temperatures virtually coincide; in the high latitudes the Venusian atmosphere at an altitude 70-90 km is systematically warmer than in the low latitudes. Beyond the limits of the 15-μm band the spectra obtained in different latitude zones also reveal systematic differences caused by the different structure of clouds in these zones. Venusian clouds cover the entire planet with a continuous layer with a thickness of about 20 km but their structure is different in different parts of the planet. New estimates for f_{H_2O} and f_{SO_2} were obtained for

altitudes of 58 and 66 km respectively. Earlier measurements were made only for lower (<50 km) and higher (>70 km) levels. Figures 2; references 3: 1 Russian, 2 Western.
[111-5303]

UDC 535.24:523.42

INFRARED EXPERIMENT ON 'VENERA-15' AND 'VENERA-16' AUTOMATIC INTERPLANETARY STATIONS. 1. METHODS AND FIRST RESULTS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 2, Mar-Apr 85 (manuscript received 26 Nov 84) pp 191-205

OERTEL, D., MOROZ, V. I., NOPIRAKOVSKIY, I., LINKIN, V. M., JAHN, H., KREMNEV, R. S., BECKER-ROSS, H., STADTHAUS, W., KERZHANOVICH, B. V., MATSYGORIN, I. A., DYACHKOV, A. V., KHLYUSTOVA, L. I., BERVALD, V., ULIKH, M., DRISHER, Kh., SKRBEK, V., SHTUDEMUND, Kh., SHUSTER, R., KAYZER, G., IGNATOVA, S. P., ZELENOV, I. A., TSERENIN, I. D., SPÄNKUKH, D., DÖHLER, W., SCHAFER, K., ZASOVA, L. V., USTINOV, Ye. A., FELLBERG, G., LIPATOV, A. N., SHURUPOV, A. A. and KHAVENSON, N. G.

[Abstract] Fourier IR spectrometers were used in obtaining planetary spectra in the range 250-1600 cm^{-1} (40-6 μm) with a resolution of about 5 cm^{-1}. Measurements were made primarily along northern hemisphere trajectories at latitudes $\varphi \geq 20°$. These instruments made it possible to discriminate on the planetary surface sectors measuring up to 60 km near pericenter. Instrument design is described (a block diagram is included) and its technical specifications and the program for work in orbit are discussed. The instrument consists of 4 units (1 optical, 3 electronic). All these units are mounted outside the station on the shaded side. The optical unit and interferometer, rotating mirror system (described in detail) and independent heat regulation system have a total mass of 15 kg; they are mounted on a special support ensuring a definite orientation of the sighting direction. The electronic units, with a total mass of 15 kg, are on the outside of the station. An on-board computer transforms the data at a real time scale and transmits them to earth. The satellite orbits were corrected several times. A block diagram of the program for the processing of these data on earth is given and discussed. Three spectra are discussed in detail. There is a minimum of three characteristic groups of spectra corresponding to different regions of the planet. The spectra obtained in the experiment were used in obtaining new data on chemical composition at altitudes 60-70 km (V. I. Moroz, et al, KOSMICH. ISSLED., Vol 23, No 2, 1985), on temperatures above the clouds (D. Spänkuch, et al., KOSMICH. ISSLED., Vol 23, No 2, 1985), on structure of the upper cloud layer (L. V. Zasova, et al., KOSMICH. ISSLED., Vol 23, No 2, 1985) and on the fluxes of outgoing thermal radiation (V. M. Linkin, et al., KOSMICH. ISSLED., Vol 23, No 2, 1985). Figures 12; references 22: 10 Russian, 12 Western.
[93-5303]

UDC 535.24:523.42

INFRARED EXPERIMENT ON 'VENERA-15' AND 'VENERA-16' AUTOMATIC INTERPLANETARY STATIONS. 2. PRELIMINARY RESULTS OF TEMPERATURE PROFILE RETRIEVAL

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 2, Mar-Apr 85 (manuscript received 26 Nov 84) pp 206-220

SPANKUCH, D., ZASOVA, L. V., SCHÄFER, K., USTINOV, Ye. A., GYULDNER, Yu., MOROZ, V. I., DÖHLER, W., LINKIN, V. M., DYUBUA, R., DYACHKOV, A. V., BECKER-ROSS, H., LIPATOV, A. N., STADTHAUS, W., MATSYGORIN, I. A., OERTEL, D., KERZHANOVICH, V. V., NOPIRAKOVSKIY, I., JAHN, H., FELLBERG, G., SHUSTER, R. and SHURUPOV, A. A.

[Abstract] One of the important types of information received in the IR experiment is temperature profiles of the Venusian atmosphere in the altitude range from approximately 60 to 95 km. Earlier studies of atmospheric structure at these altitudes included: measurements of accelerations arising during braking of descent modules in the atmosphere, measurements of radio signal parameters during radio occultations and intensity measurements in the band CO_2 λ15 μm using filters. These earlier results were generalized in several atmospheric models but the initial data in large part were scattered or not simultaneous. The new IR measurements were made using a greater number of channels, making it possible to obtain more detailed data on the temperature profiles. The fact that the entire spectrum was registered, not its individual points, is very important because only this makes possible a reliable determination of the contribution of clouds to planetary radiation. These new data revealed that within the latitude zone $\pm 60°$ the temperature decreases monotonically with altitude. Typical temperatures at 70 km ($P \approx 0.3$ mbar) are about 230 K, at 80 km ($P \approx 3$ mbar) about 200 K and at 90 km ($P \approx 0.3$ mbar) drop to 180 K. At latitudes +60° in the region $10 < P < 100$ mbar in an inversion usually occurs or isothermy prevails. At latitudes $\varphi > +60°$ the atmosphere is warmer than in the temperate and low latitudes. The temperature difference between the high and low latitudes attains 20 K at 70 km and decreases to 5 K at 90 km. Daytime temperature almost coincide with nighttime temperatures. However, data processing has only begun, but the temperature retrieval procedure has been perfected. Although some improvements are possible, they will not result in any significant changes in the temperature profiles. Figures 15; tables 1; references 31: 15 Russian, 16 Western.
[93-5303]

UDC 535.24:523.42

INFRARED EXPERIMENT ON 'VENERA-15' AND 'VENERA-16' AUTOMATIC INTERPLANETARY STATIONS. 3. SOME CONCLUSIONS ON CLUOD STRUCTURE BASED ON ANALYSIS OF SPECTRA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 2, Mar-Apr 85
(manuscript received 26 Nov 84) pp 221-235

ZASOVA, L. V., SPANKUCH, D., MOROZ, V. I., SCHAFER, K., USTINOV, Ye. A., DOHLER, W., LINKIN, V. M., OERTEL, D., DYACHKOV, A. V., BECKER-ROSS, H., MATSYGORIN, I. A., NOPIRAKOVSKIY, I., KERZHANOVICH, V. V., DYUBUA, R., LIPATOV, A. N., STADTHAUS, W. and SHURUPOV, A. A.

[Abstract] The thermal emission spectra of Venus in the range 250-1600 cm^{-1} have considerable differences in different parts of the planet, especially in the high latitudes. Some of these variations are attributable to the fact that Venusian clouds have a different structure in different parts of the planet. The series of spectra obtained in scanning along the meridian can be divided into several groups whose peculiarities are at least in part related to the characteristics of cloud structure in different zones. There was a good agreement between the measured spectra and synthetic spectra computed on the supposition that cloud particles consist of sulfuric acid. In the low latitudes ($\varphi<60°$) cloud transparency in the long-wave part of the spectrum ($\nu<500$ cm^{-1}) is so great that a considerable part of the outgoing radiation is formed in the middle cloud layer ($53<H<58$ km). The spectra obtained in the low latitudes agree with the synthetic spectrum computed using an apriori model making use of the particle-size distribution and numerical concentrations of particles obtained in direct measurements and surface astronomical observations if one, the other or both are corrected. The spectra obtained at all latitudes agree satisfactorily with the synthetic spectra computed using simplified cloud models. The cloud structure at latitudes $\varphi<60°$ is evidently identical on the daytime and nighttime sides of the planet. In a hot spot located at latitudes 78-82° the upper cloud boundary is lower than in all other regions of the planet. Figures 6; tables 7; references 20: 5 Russian, 15 Western.
[93-5303]

UDC 535.24:523.42

INFRARED EXPERIMENT ON 'VENERA-15' AND 'VENERA-16' AUTOMATIC INTERPLANETARY STATIONS. 4. PRELIMINARY RESULTS OF ANALYSIS OF SPECTRA IN REGION OF H_2O AND SO_2 ABSORPTION BANDS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 2, Mar-Apr 85 (manuscript received 26 Nov 84) pp 236-247

MOROZ, V. I., DÖHLER, W., USTINOV, Ye. A., SCHÄFER, K., ZASOVA, L. V., SPÄNKUKH, D., DYACHKOV, A. V., DYUBUA, R., LINKIN, V. M., OERTEL, D., KERZHANOVICH, V. V., NOPIRAKOVSKIY, I., MATSYGORIN, I. A., BECKER-ROSS, H., SHURUPOV, A. A., STADTHAUS, W. and LIPATOV, A. N.

[Abstract] About 1,500 planetary spectra were obtained in the range 250-1600 cm^{-1} and numerous absorption details were visible. This article contains arguments confirming the identification of SO_2 and gives examples of the first quantitative estimates of the content of H_2O and SO_2 on the basis of a small number of spectra. Emphasis is on the fundamental $\nu_2 H_2O$ rotational-vibrational band. Two SO_2 absorption bands are documented (ν_2 at about 519 cm^{-1} and ν_3 at about 1360 cm^{-1}). It is shown that the estimates of the abundance of H_2O and SO_2 are critically dependent on the choice of temperature profiles and cloud models. Although both can be found using data from the experiment itself, remaining uncertainties exert an appreciable influence on quantitative estimates. The H_2O mixing ratio at an altitude of 50 km is 30 ppm with an accuracy to a factor of 3. The SO_2 mixing ratio at an altitude of 66 km is 2 ppm with an accuracy to this same factor. Both mixing ratio estimates were obtained on the basis of an analysis of spectra registered on 14 October 1983 in the temperate latitudes. Figures 8; tables 2; references 30: 14 Russian, 16 Western. [93-5303]

UDC 535.24:523.42

INFRARED EXPERIMENT ON 'VENERA-15' AND 'VENERA-16' AUTOMATIC INTERPLANETARY STATIONS. 5. PRELIMINARY RESULTS OF ANALYSIS OF BRIGHTNESS TEMPERATURE AND HEAT FLOW FIELDS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 2, Mar-Apr 85 (manuscript received 26 Nov 84) pp 248-258

LINKIN, V. M., SCHÄFER, K., MATSYGORIN, I. A., DÖHLER, W., MOROZ, V. I., DYUBUA, R., DYACHKOV, A. V., SPÄNKUKH, D., KERZHANOVICH, V. V., OERTEL, D., ZASOVA, L. V., NOPIRAKOVSKIY, I., USTINOV, Ye. A., BECKER-ROSS, H., LIPATOV, A. N., STADTHAUS, W. and SHURUPOV, A. A.

[Abstract] Other articles in this series gave a preliminary analysis of results obtained in the IR experiment on the "Venera-15" in spectral form. However, the same data can be represented differently, as meridional brightness

temperature profiles at selected frequencies for each particular measurement session or as zonal brightness temperature profiles. The behavior of the radiation flux can also be examined as a function of latitude and local solar time. This article gives the first zonal profiles (brightness temperatures and heat flows in fixed latitude ranges as a function of time). It was found that in the Venusian northern hemisphere the field of brightness temperatures and flows contains three characteristic regions: low latitudes (to 40-50°), where the brightness temperatures and flows are almost constant; cold zone (60-75°), evidently unclosed latitudinally and with great variations of T_B and heat flows; a "warm" polar cap where the heat flows are maximum and rather stable, but with hot spots. There is no thermal asymmetry (the brightness temperature on the daytime side is greater than on the nighttime side) in the low latitudes. This pertains at least to the range of local solar time 56-155°. The reported observations fail to give an independent confirmation of the dual structure of hot spots near the north pole, or "dipole." On the other hand, they do not contradict the hypothesis that this structure as a whole has persisted for the five years elapsing since first detection by the Pioneer-Venus satellite. The cold zone does not rotate together with the atmosphere but is localized in the region adjacent to the morning terminator. Figures 7; references 9: 6 Russian, 3 Western.
[93-5303]

UDC 535.24:523.42

VENUSIAN INFRARED RADIATION: APPROXIMATE METHODS FOR COMPUTING SPECTRUM IN ABSORPTION BANDS OF ATMOSPHERIC GASES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 2, Mar-Apr 85 (manuscript received 26 Nov 84) pp 259-267

MOROZ, V. I. and ZASOVA, L. V.

[Abstract] In the "Venera-15" and "Venera-16" IR experiment, spectra of outgoing planetary radiation were obtained in the range 250-1600 cm^{-1}. In interpreting these spectra it is necessary to find a set of atmospheric parameters (temperature profile, cloud composition and profile, gas composition) which gives a so-called synthetic spectrum coinciding with the measured spectrum and to evaluate the admissible scatter of these parameters. Since the observed spectra have a substantially different form in different planetary regions, it is necessary to use a computation method making it possible to obtain the synthetic spectrum quite rapidly, stipulating a definite set of atmospheric parameters. The measurements were preceded by computations of the CO_2, H_2O and SO_2 transmission functions for the Venusian atmosphere by a rigorous line-by-line method (W. Döhler, et al., REPORT FOR VIRA WORKSHOP, Hamburg, 1983). Some a priori models of T(H) temperature profiles and F_{H_2O} and F_{SO_2} gas mixing ratios, based on current information,

were stipulated. The CO_2 transmission functions became the basis for interpreting measurements with respect to retrieval of the temperature profiles and virtually no correction was required. This was not true of the gas transmission functions obtained for H_2O and SO_2, but a line-by-line computation could not be repeated due to the massive work involved. Accordingly, in analyzing the IR data (L. V. Zasova, et al. and V. I. Moroz, et al., KOSMICH. ISSLED., Vol 23, No 2, 1985) use was made of approximate methods for computing the synthetic spectrum. Three cases are examined separately: H_2O, CO_2 and SO_2 absorption details. In the case of the H_2O bands, a simplified variant of the line-by-line method is used; for CO_2 use is made of the approximation of equally distant lines with moving values of the Elsasser band parameters; for SO_2 the approximation of overlapping lines is employed. Figures 3; references 19: 12 Russian, 7 Western.
[93-5303]

UDC 523.42

VENUSIAN IMPACT CRATERS ON RADAR IMAGES OF 'VENERA-15' AND 'VENERA-16' SPACECRAFT

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 282, No 3, May 85 (manuscript received 16 Oct 84) pp 671-674

BAZILEVSKIY, A. T., IVANOV, B. A., KRYUCHKOV, V. P., KUZMIN, R. O., PRONIN, A. A. and CHERNAYA, I. M., Geochemistry and Analytical Chemistry Institute imeni V. I. Vernadskiy, USSR Academy of Sciences; Physics of Earth Institute imeni O. Yu. Shmidt, USSR Academy of Sciences, Moscow

[Abstract] The reliable identification of impact craters on Venus and proof of their origin was possible only using the radar images transmitted to earth by the "Venera-15" and "Venera-16" satellites. On these images, having a resolution of 1-2 km, it was possible to discriminate craters morphologically very similar to impact craters on the Moon, Mercury and Mars. They can be reliably interpreted beginning with a diameter of about 10 km; the largest are 100-140 km in diameter. These features are superposed on different geomorphological provinces: smooth plains, dissected plains with concentric and radial-concentric structures, regions of ridged relief and high-mountain volcanic plateaus. The article defines, discusses and illustrates the different types of craters which have been discovered. Morphological data who that on Venus, as on other planets, with an increase in crater size there is a change in their morphological type (the threshold diameter of change of one morphological type of crater to another is dependent on the acceleration of free falling onto the planet and the nature of the rocks at the impact point). Despite the presence of a very dense atmosphere and a high surface temperature, the morphology and mechanisms of formation of impact craters on Venus are virtually identical to those on other planets with sharply different surface conditions. However, it can be postulated that the higher temperature of Venusian rocks results in formation of a greater

quantity of impact vapor and melt per unit of impact energy than on other planets of the earth group. The fate of the impact vapor also should be different due to the greater atmospheric pressure. Expansion of the cloud of impact vapor will be stopped by the surrounding atmosphere. Figures 4; references 6: 3 Russian, 3 Western.
[101-5303]

UDC 550.81:523.42

VENUSIAN EXOGENOUS PROCESSES AND SURFACE ROUGHNESS DETERMINED FROM RADAR OBSERVATIONS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 2, Mar-Apr 85 (manuscript received 18 Oct 83) pp 268-275

KRYUCHKOV, V. P. and PRONIN, A. A.

[Abstract] An attempt was made to establish a correlation between elevation and degree of roughness of the Venusian surface at two scales for the entire surveyed territory of the planet for determining possible genetic relationships between these parameters. The study was based on data furnished by American scientists: Mercator-projection maps at 1:50,000,000 showing the distribution of rises above the mean planetary level and roughness at the centimeter and decameter scales of irregularity. With allowance for hypsometry, slope gradients and panoramic images of the surface at points of landing of the "Venera" stations (and other factors) additional confirmation was obtained of the existence of a correlation between roughness and elevation. At high hypsometric levels (>4 km), where great roughness prevails, there is a predominance of destruction of consolidated rocks with down-slope movement of clastic material and removal of the fine fraction, possibly favored by eolian and other processes. At intermediate hypsometric levels (4-2 km), where intermediate roughness prevails, there is primarily destruction of consolidated rocks with self-burial by local clastic material and the eolian process. At low hypsometric levels (<2 km), where intermediate and low roughness predominate, it is postulated that there is an accumulation of the fine fraction, possibly with subsequent lithification and formation of layered rocks. Still unclear is the contribution of the products of volcanic and impact processes to the fine fraction transported by the wind. Figures 3; tables 2; references 12: 6 Russian, 6 Western.
[93-5303]

UDC 535.37:523.42

ANALYSIS OF ERRORS IN RESULTS OF RADIO PROBING OF DAYTIME VENUSIAN IONOSPHERE CAUSED BY ITS ASPHERICITY

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 1, Jan-Feb 85 (manuscript received 17 Mar 83) pp 148-157

GAVRIK, A. L. and SAMOZNAYEV, L. N.

[Abstract] Errors in determining the vertical profiles of electron concentration in the Venusian daytime ionosphere caused by its asphericity are analyzed and the possibilities of using a spherically symmetric approximation of solution of the inverse problem for radio occultations of the "Venera-9" and "Venera-10" satellites are examined. An approach to the problem is proposed which makes it possible to investigate asymmetry in the case of an arbitrary orientation of the satellite orbital plane for all cases when radio probing is possible. An ionospheric model is proposed which is consistent with the experimental data. It was found that the error δN in determining the N(h) profiles caused by the influence of asymmetry exerted no influence on the main results obtained by the two-frequency radio probing method from these satellites. The absolute error $|\delta N|$ caused by change in the solar zenith angle along the radio ray in the ionosphere did not exceed $\sim 10^4$ cm^{-3} and exerted virtually no influence on the electron concentration distribution in the region of the main and lower maxima in the Venusian daytime ionosphere. The $|\delta N|$ value was commensurable with the experimental errors and was maximum when the orbital plane fell in the plane of ecliptic and was minimum with a sun-space vehicle-earth angle $\varepsilon = 90°$. The asymmetry influence in the upper atmosphere was greatest with a solar zenith angle ~70°. The error in determining ionopause altitude can attain ~200 km and scale height ~50 km; it is maximum when $\varepsilon = 20°$ and is insignificant when $\varepsilon \approx 90°$. Figures 4; tables 1; references 16: 5 Russian, 11 Western. [90-5303]

UDC 523.42

PRINCIPAL TYPES OF STRUCTURES IN VENUSIAN NORTHERN HEMISPHERE

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 19, No 1, Jan-Mar 85 (manuscript received 16 Nov 84) pp 3-14

BARSUKOV, V. L., BAZILEVSKIY, A. T., KUZMIN, R. O., MARKOV, M. S., KRYUCHKOV, V. P., NIKOLAYEVA, O. V., PRONIN, A. A., SUKHANOV, A. L., CHERNAYA, I. M., BURBA, G. A., BOBINA, N. N. and SHASHKINA, V. P., Geochemistry and Analytical Chemistry Institute imeni V. I. Vernadskiy, USSR Academy of Sciences

[Abstract] Mapping of the Venusian northern hemisphere has made it possible to draw a whole series of important conclusions concerning the planet. There

is no evidence of activity of liquid water. If a hydrosphere ever existed, it disappeared much more than a billion years ago. At the survey scale it is impossible to detect evidence of eolian erosion or redeposition. If the planet ever rotated more rapidly and stronger winds prevailed, this must have been over a billion years ago. Due to the weakness of exogenous reworking, in the Venusian relief there is a clear expression of deep dislocations corresponding in age to the Proterozoic complex on the earth (on the earth only observed at considerable depths). Tectonic dislocations of three types predominate on Venus: concentric annular ovoids, zones of linear folded-faulted dislocations and "parquette" dislocations. The latter constitute a phenomenon caused by a high temperature at the planetary surface, as a result of which large plates of the thin crust move along a plastic substrate or are entrained by it and are crumpled, hummocked and dilatated. Venus is not a "single-plate" planet, like the moon or Mercury; its crust is distinctly broken into individual blocks with independent movements. It appears that extensive basaltic volcanism is a universal factor in evolution of planets of the earth type. The rarity of impact craters in the ancient relief indicates that they disappeared rather rapidly due to a number of possible mechanisms. Figures 8; references 11: 4 Russian, 7 Western.
[5-5303]

UDC 523.42

RADIATIVE HEAT TRANSFER AND WATER CONTENT IN VENUSIAN ATMOSPHERE

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 19, No 1, Jan-Mar 85 (manuscript received 3 Dec 84) pp 15-41

MAROV, M. Ya., GALTSEV, A. P. and SHARI, V. P., Applied Mathematics Institute imeni M. V. Kerdysh, USSR Academy of Sciences

[Abstract] After a review of the literature, the authors describe a method for computing the optical characteristics of the main components and effective radiative fluxes in the Venusian atmosphere and give specific results of computations. These data are compared with the results published by other authors. As a priori information on the structure and chemical composition of the atmosphere use was made of the COSPAR model, based on "Venera" and "Pioneer Venus" measurements. The optical model used was a model of a non-scattering, absorbing atmosphere consisting of 97% CO_2 and small admixtures of H_2O and SO_2. The optical properties of such a model are determined by the IR absorption spectrum of these gases. The described method with use of data on the absorption coefficients was used in computations of the effective flux for a purely carbon dioxide atmosphere and for an atmosphere containing water vapor with different mixing ratios for different vertical profiles of temperature and cloud cover albedo. Estimates of the contribution of sulfur dioxide to atmospheric opacity were made. For example, Fig. 9 shows the fluxes for different cloud cover albedo values and different water vapor contents; Fig. 10 shows the effective radiative flux for different water vapor contents; Fig. 11 shows radiative fluxes for different H_2O

contents computed by different authors; Fig. 12 gives comparisons of various computed models of water vapor content and data from the "Pioneer Venus" experiment. The probable sources of errors exerting an influence on the discrepancies between theoretical and experimental data are discussed. Figures 13; tables 3; references 58: 30 Russian, 28 Western.
[5-5303]

UDC 551.510.53

MODEL OF COMPOSITION OF MARTIAN IONOSPHERE IN PHOTOCHEMICAL EQUILIBRIUM REGION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 2, Mar-Apr 85 (manuscript received 1 Aug 83) pp 276-282

PAVLOV, A. V.

[Abstract] Models of the Martian ionosphere published by W. B. Hanson, et al., R. H. Chen, et al. and J. L. Eox, et al. took into account only the concentration N_i of the ions N_2^+, H^+, O_2^+, CO_2^+, O^+ and NO^+. However, the ionosphere contains other ions, including C^+, CO^+ and N^+. Experience in modeling the composition of the Venusian ionosphere shows that transformation from the most possible complete model of chemical reactions to simpler models results in errors in N_e and N_i. Accordingly, in this connection it is unclear how accurate the models of chemical and photochemical reactions proposed in the American literature might be. In this article the point of departure is the most complete possible model in order to discriminate important and unimportant reactions (the model used is given by M. N. Izakov, et al., KOSMICH. ISSLED., Vol 19, No 5, p 733, 1981). This makes it possible to evaluate the accuracy of simplified models of the reactions and obtain analytical expressions for N_i and N_e. Attention is given to variations in ionospheric composition during the solar activity cycle. The model of composition of the Martian daytime ionosphere at altitudes from 110 to 220 km contains the following ions: O_2^+, CO_2^+, O^+, H^+, He^+, NO^+, C^+, N^+, CO^+, N_2^+, CO_2H^+, COH^+, OH^+ and electrons. Theoretical models of n_n, T_n, T_e variations during the solar activity cycle were used to compute N_e and N_i for high solar activity. The changes of N_e, N_i with solar zenith angle were evaluated. A group of ions, O^+, O_2^+, CO_2^+, CO^+ and C^+ was defined whose concentrations are determined by reactions with participation of these ions. Reactions with the participation of other ions give an approximately 5-20% contribution to the photochemical balance of these ions. Analytical expressions were derived for N_e and N_i. The relative error in theoretical computations of N_e caused by errors in measuring the input parameters of the model is 18-25%. (Other errors were also determined.) Figures 2; tables 2; references 23: 7 Russian, 16 Western.
[93-5303]

UDC 551.510.41:551.521.3:551.58

COMPARATIVE ANALYSIS OF VOLCANIC EFFECT ON CLIMATE OF EARTH AND MARS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 21, No 5, May 85 (manuscript received 15 Nov 83, after revision 27 Jan 84) pp 451-459

KONDRATYEV, K. Ya., MOSKALENKO, N. I., PARZHIN, S. N. and SKVORTSOVA, S. Ya., Limnology Institute, USSR Academy of Sciences

[Abstract] Volcanism is a highly important factor resulting in climatic changes on a global scale. Its climatic effect has had considerable temporal fluctuations on the Earth and on Mars. Volcanic explosions change both atmospheric aerosol composition and its gas composition. With intensification of volcanic activity there is increased ejection of SO_2 into the stratosphere and troposphere. SO_2 has strong bands in the UV and IR and therefore an increase in the SO_2 concentration reduces planetary albedo and increases the influx of short-wave radiation to the planet and effective temperature of the planet. Strong IR bands result in an intensification of radiative cooling of the troposphere and finally an enhancement of the greenhouse effect. The article discusses modeling of optical properties of the evolving atmosphere and the climatic effect of volcanism in the course of the earth's evolution, followed by a parallel examination of the climatic effect of volcanism in the process of evolution of Mars. The principal features of radiative heat exchange in the Martian atmosphere for a period of volcanic activity are: strong absorption of short-wave radiation by atmospheric SO_2 in the range of 0.2-0.4 μm results in a decrease in planetary albedo and formation of a temperature inversion in the upper layers of the atmosphere; formation of clouds from particles of aqueous solutions of sulfuric acid causes an increase in planetary albedo and an intensification of the greenhouse effect due to the absorption of long-wave radiation in the bands of H_2SO_4 aqueous solutions; strong SO2 IR bands enhance the atmospheric greenhouse effect and favor an increase in temperature of both the atmosphere and planetary surface. The hypothesis of a denser Martian atmosphere in the presence of great discharges of volcanic gases makes it possible to explain the warmer and moister Martian climate in the earlier stages of its evolution. On the other hand, a considerable reduction of volcanism resulted in strong planetary cooling. After evaporation Martian water was in part dissociated and in part was collected in the form of glaciers near the poles. Many of the observed surface features on Mars can be traced to the greenhouse effect of an atmosphere having a chemical composition different from the present-day Martian atmosphere. Figures 3; tables 2; references 15: 10 Russian, 5 Western.
[97-5303]

UDC 523.4

GLOBAL RESONANCE OF JOVIAN RADIATION BELTS

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 11, No 1, Jan 85 (manuscript received 14 Jun 84) pp 72-77

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[Abstract] Experiments carried out by Pioneer-10 indicated that the electron fluxes in the Jovian radiation belts are modulated with the period of planetary rotation, but it was not determined whether this 10-day modulation is spatial or temporal. E. J. Smith proposed a spatial modulation model, postulating that the space vehicle may periodically be in zones of strong and weak streams of particles, but no confirmation has been obtained. On the other hand, an analysis of the phase of the envelope of streams of high-energy electrons in the solar wind in the stage of approach to the planet and during withdrawal from it enabled J. A. Simpson to postulate a temporal character of the modulation. D. L. Chenette and others used several qualitative models for explaining this effect, but difficulties were involved. Acoordingly, in this article the author proposes a theoretical model of the temporal modulation of the parameters of the electron radiation belts of Jupiter which gives a quite natural explanation of the experimental data. The oscillation regimes of cyclotron instability in the belts are investigated. It is shown that essentially the eigenfrequencies of these oscillations in the outer Jovian magnetosphere are not dependent on the magnetic shell and coincide with the planetary velocity of rotation. Such a global resonance explains the observed data on intense time modulation of parameters in the outer radiation belts. References 7: 2 Russian, 5 Western.
[85-5303]

UDC 523.3+552.12+622.02

PRELIMINARY RESULTS OF DETERMINATIONS OF PHYSICAL PROPERTIES OF MICROFRAGMENTS OF LUNAR ROCKS FROM SOIL RETURNED BY 'LUNA-16' AND 'LUNA-20' STATIONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 283, No 3, Jul 85 (manuscript received 20 Oct 83) pp 601-604

GORBUNOV, G. I., corresponding member, USSR Academy of Sciences, MEDVEDEV, R. V. and CHASHNIKOV, V. V., Mining Institute, Kola Affiliate imeni S. M. Kirov, USSR Academy of Sciences, Apatity, Murmansk Oblast

[Abstract] A number of "Luna" vehicles returned with samples of lunar soil (basalts, anorthosites, breccias, slags, glass). Special methods were required for working with microgragments measuring a fraction of a millimeter. Material from the "Luna-24" was described by I. A. Turchaninov

in DAN, Vol 252, No 2, 1980. Such work has been continued in this description of 13 particles of soil returned by the "Luna-16" and "Luna-20." The former made a landing in a mare region, the latter in a continental region. The tested particles were selected in the Comparative Planetology Laboratory, Geochemical and Analytical Chemistry Institute. They included: two samples of melanocratic basalts, two samples of anorthositic gray rock, four types of glass from mare and continental regions, one light-colored breccia, one dark gray porous slag particle, three grains of rock-forming minerals (pyroxene with numerous inclusions, light-yellow olivine of irregular configuration and a transparent grain of plagioclase. The following parameters were determined: density, longitudinal elastic modulus, heat capacity, compressive strength, Young modulus. All these determinations are tabulated. The results of these tests of microsamples of lunar rocks agree with determinations made in the United States with macrosamples and also with averaged indices of properties for similar terrestrial rocks. The collected data can be useful for interpreting lunar geophysical data. Tables 1; references 11: 6 Russian, 5 Western.
[120-5303]

UDC 522.6+523.3+523.4

POLARIMETRIC STUDIES OF MOON AND PLANETS AT ABASTUMANI ASTROPHYSICAL OBSERVATORY

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 19, No 1, Jan-Mar 85 (manuscript received 21 Nov 84) pp 77-85

DZHAPIASHVILI, V. P., BOLVADZE, O. R., KVARATSKHELIYA, O. I., KOROL, A. N. and SIGUA, L. A., Abastumani Astrophysical Observatory, Georgian Academy of Sciences

[Abstract] Abastumani Observatory has long been noted for polarimetric investigations of celestial bodies. Such observations are made using the 40-cm F/17 Zeiss refractor which is free of instrumental polarization. The telescope is guided on the object with an accuracy better than 1". A significant series of lunar brightness images has been obtained and these have been used in publishing an atlas containing 21 such lunar maps for different phase angles. A detailed study was made of more than a hundred different features on the moon, with particular attention being devoted to the accuracy in measuring maximum and minimum polarization and the inversion angle in different parts of the spectrum. Exotic phenomena were discovered on the moon, especially near Aristarchus Crater, where high degrees of polarization of several small surface sectors were repeatedly measured. Polarimetric observations at the observatory have been made since 1967. Observations were made on 170 nights and more than 10,000 individual measurements were made. This made possible a clear visualization of the quantitative picture of the distribution of polarization over the apparent disk and the nature of its change over a long time interval. The change

in the degree of polarization at the eastern and western limbs of the equatorial zone from opposition to opposition, the difference in polarization for east and west and the dependence of this difference on wavelength indicate the following. At the limbs of the equatorial zone the height of the boundary of transition of the cloud layer into the gas atmosphere above the clouds changes with time. With a change in height of the transition layer there is also a change in the optical thickness of the atmosphere above the clouds. The polar regions of Jupiter have a high degree of polarization, which is highly dependent on planetocentric latitude. With an increase in latitude, polarization increases monotonically and assumes a maximum value over the polar regions. Graphic polarimetric maps of Jupiter were constructed for 10 different phase angle values. Polarimetric observations of Saturn began in 1972; observations were made on more than 300 nights. For the central part of the disk the degree of polarization is not dependent on the longitude of the central meridian. There were no short-period changes in polarization, but there were year-to-year changes. A method has been developed for determining the optical thickness of the rings of Saturn. The observatory is making polarimetric investigations of Uranus and the bright satellites of Jupiter and certain asteroids. Figures 10; references 16: 15 Russian, 1 Western.
[5-5303]

UDC 62-501-12

CHANGE IN ANGULAR POSITION OF SPACECRAFT BY SYSTEM OF FLYWHEEL MOTORS WITH NONZERO INITIAL KINETIC MOMENT

Moscow IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA in Russian
No 3, May-Jun 85 (manuscript received 27 Jan 84) pp 3-7

ALEKSEYEV, K. B. and ZLODYREVA, O. V., Moscow

[Abstract] The control of change in angular position of a spacecraft, so-called extensive or direction change, by means of jet engines or flywheel motors has been thoroughly discussed in the literature, but with respect to orientation systems with flywheel motors the results of theoretical research are correct only on the assumption that the initial value of the kinetic moment of the system of flywheels is equal to zero. By contrast, this article gives an analytical solution of the problem of control of the spatial reorientation of a spacecraft by a single plane change in angular position by a system of flywheels with an initial nonzero kinetic moment of the latter. It is assumed that the influence of external effects on the rotational motions of the vehicle is negligible. Dynamic equations for rotational motions, supplemented by kinematic equations, are written which form a full system of equations for describing changes in the angular position of the vehicle by means of internal moments. It is assumed that there are three groups of identical flywheels, of which the first performs the required change in angular position of the vehicle about the Euler axis, whereas the other two compensate the gyroscopic moment caused by the kinetic moment of the flywheels in the third group. Using the property of additivity of the vector of kinetic moment of the mechanical system "vehicle body - flywheel motors" and the condition of total compensation of the influence of the gyroscopic moment on the rotational motions of this system it is possible to examine the dynamics of the two dynamic processes separately. On this basis it was possible to write algorithms for solving this problem which make it possible to define a program of change of the controlling forces in the drive motors of the flywheels with a maximum speed and with allowance for natural limitations. Figures 3; references: 4 Russian.
[105-5303]

UDC 629.7

INFLUENCE OF AERODYNAMIC MOMENT ON GRAVITATIONAL ORIENTATION REGIME FOR 'SALYUT-6'-'SOYUZ' COMPLEX

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 1, Jan-Feb 85 (manuscript received 19 Apr 83) pp 63-83

SARYCHEV, V. A. and SAZONOV, V. V.

[Abstract] Within the framework of a simple mechanical model a study was made of the motion of the "Salyut-6"-"Soyuz" orbital complex relative to its center of mass in a uniaxial gravitational orientation regime. The satellite is assumed to be a solid body having the configuration of a cylinder to which are attached three plates, solar cells. The orbit of the satellite center of mass in absolute space is considered circular. The effect of gravitational and restoring aerodynamic moments on the satellite is taken into account. The satellite equations of motion allow the natural introduction of a small parameter: the ratio of the longitudinal moment of inertia to the transverse moment of inertia. The Krylov-Bogolyubov method is used in constructing formal two-parameter integral surfaces of these equations describing oscillations and rotations of the satellite about the longitudinal axis directed approximately along the local vertical. Such satellite motions can be regarded as nominal unperturbed motions in a gravitational orientation regime. A numerical investigation of these integral surfaces was carried out. The resonances between satellite motion about its longitudinal axis and oscillations of this axis relative to the local vertical considerably intensify the influence exerted on the satellite by the nonpotential component of the aerodynamic moment. Examples are given in which such intensification results in strong oscillation of the Satellite and disruption of the gravitational orientation regime. With an appropriate choice of initial conditions of motion this instability would be extemely weak and would not impair the gravitational orientation regime for at least several weeks. Figures 12; tables 4; references 8: 7 Russian, 1 Western.
[90-5303]

UDC 629.87

MATHEMATICAL MODEL OF PLANETARY ROVER MOVEMENT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 23, No 1, Jan-Feb 85 (manuscript received 12 May 83) pp 92-99

GRIGORYEV, Ye. I. and YERMAKOV, S. N.

[Abstract] The mathematical modeling of spatial movement of a wheeled planetary rover along an arbitrary surface is examined. The article is essentially a continuation of earlier work on this subject by the authors (KOSMICH. ISSLED., Vol 22, No 4, p 543, 1984). The proposed model of

movement and can be used as part of a more complex model of control of motion of a self-contained vehicle. Using the most universal method for describing arbitrary relief--point and linear interpolation for successive points--the results obtained in the earlier study can be used in describing the conditions for interaction with microrelief elements, determination of the coordinates of contact points and the force factors acting on the wheels, in writing the equations of motion and in performing their numerical integration. The following aspects of the problem are examined in detail: position of wheel in a base coordinate system; conditions for contact of wheels and surface elements and determination of coordinates of contact points; zones of possible interaction; model of wheel rim; ground characteristics; area of contact between element and wheel. Figures 7; references: 5 Russian. [90-5303]

/9835

SATELLITE RADAR USED FOR STORM FORECASTING

Kiev PRAVDA UKRAINY in Russian 21 Aug 85 p 4

[Article by V. Gatash and V. Nat]

[Text] A radar developed by scientists of the Ukrainian Academy of Sciences' Institute of Radiophysics and Electronics is capable of seeing the origin of a typhoon or hurricane from space and calculating its force and direction.

"A strip of ocean or land that is 500 kilometers wide falls within the field of view of this radar, which is installed on the satellites 'Cosmos-1500' and 'Cosmos-1602; we can therefore observe the structure of any center of atmospheric disturbance in its dynamic development," said project director A. I. Kalmykov. "In pictures, the 'eye' of a hurricane, for example, is clearly visible as a spot of quiet water with winds raging around it. The main task here is to determine the energy of this threatening natural phenomenon quickly. After all, far from every typhoon has destructive force. Such details of the storm as the height of wave caps can be seen easily, on the basis of which the storm's possible destructive force can be forecast."

Typhoon warnings are only one specialty of the space radar developed in Kharkov. It can also be used for comprehensive study of the planet's surface. It has been used with success in guiding ships along the Northern Sea Route, determining the boundaries of spring flooding of rivers, and analyzing the structure and condition of sowings of farm crops.

FTD/SNAP/9835
CSO: 1866/38

FURTHER COMMENTARY ON SATELLITE RADAR SYSTEM

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 8 Sep 85 p 4

[Article by V. Nat and V. Gatash (Khar'kov)]

[Excerpt] The origin of a typhoon can be seen from space and its force and direction calculated with the aid of a radar system that has been developed at the Ukrainian Academy of Sciences' Institute of Radiophysics and Electronics.

Everyone remembers the tense days of the rescue of the motor ship "Mikhail Somov". The icebreaker "Vladivostok", which led this ship to open water through breaks in the ice, found the "Somov" in the vast ice mass largely with the aid of radar installed on the satellite "Cosmos-1500".

"By studying features of the reflection of radio waves from the Earth's surface, we obtain a wealth of information on the structure of the ground or the upper layers of the ocean," said A. Kalmykov, head of the institute's department of remote methods for studying the natural environment. "Moreover, neither night nor cloud cover pose an obstacle for the 'radar eye.' Scanning a strip 500 kilometers wide, it distinguishes objects less than a kilometer in size."

Operating together with conventional optical systems, this radar system opens up entirely new possibilities for studying the Earth from space. An active volcano has been discovered beneath the ice of Antarctica in the vicinity of James Ellsworth Land, for example.

Science associates A. Kurekin and A. Pichugin showed us sharp pictures of the Earth's surface. One can see all kinds of thins with the aid of radar. There was a whole series of pictures of hurricane "Diana" raging off the coast of Florida. The hurricane's 'eye' was clearly visible as a spot of quiet water in the midst of the storm. The observations of "Diana" demonstrated for the first time that it is possible from space not only to see the origin of hurricanes and determine the direction in which they are moving, but also to calculate their force, on the basis of the height of wave caps on the ocean's surface. V. Tsimbal and Yu. Sinitsin, the specialists who developed these original methods of calculation, think that the destructive force of hurricanes can now be forecast with assurance.

FTD/SNAP/9835
CSO: 1866/38

'COSMOS' SATELLITES USED IN AEROSPACE PHOTOGRAPHY EXPERIMENTS

Frunze SOVETSKAYA KIRGIZIYA in Russian 18 Aug 85 p 2

[Article by Vladlen, Professor, deputy chairman of the USSR Academy of Sciences' "Intercosmos" council]

[Abstract] The author comments on work that has been done recently within the framework of the socialist bloc's "Intercosmos" program of space research. Attention is focused on the organization and purposes of the series of Earth natural resources using aerospace equipment. This series, which began in 1983, has included the experiments "Black Sea-83", "Black Sea-84", "Gyunesh", and "Kursk-85".

The author notes that the experiment "Kursk-85", which took place in June of this year, and the "Gyunesh" experiments were performed within the framework of the project called "Study of Dynamics of Geosystems by Remote Methods".* The "Kursk-85" experiment was conducted in Kursk Oblast, in a scientific survey area of the USSR Academy of Sciences' Institute of Geography. This area consists of forest-steppe land that is intensively farmed. Photographs of it were made simultaneously from laboratory airplanes, helicopters, and a number of spacecraft. In addition to the manned orbiting complex "Salyut-7"—"Soyuz T-13"—"Progress-24", the spacecraft included the satellites "Cosmos-1653", "Cosmos-1657" and "Cosmos-1663".

FTD/SNAP/9835
CSO: 1866/38

UDC 550.814:528.77(235.216)

GEOLOGICAL-GEOMORPHOLOGICAL INTERPRETATION OF PHOTO IMAGE PATTERNS IN SPACE PHOTOGRAPHS FOR WESTERN PART OF FERGANA VALLEY AND ITS MOUNTAINOUS FRAMEWORK

Tashkent UZBEKSKIY GEOLOGICHESKIY ZHURNAL in Russian No 4, Jul-Aug 85 (manuscript received 26 Dec 84) pp 52-56

MAGZUMOVA, D., Geology and Geophysics Institute imeni Kh. M. Abdullayev, Uzbek Academy of Sciences

[Abstract] A detailed analysis of photo image patterns was carried out using multizonal photographs at 1:1,000,000 obtained from the LANDSAT satellite in four spectral ranges in the western part of the Fergana valley and the mountains surrounding it. With respect to geomorphological analysis of the patterns, the most informative photographs were obtained in the spectral zone 0.8-1.1 μm. The territory was represented by three major geomorphological types: mountainous uplifts, made up primarily of Plaeozoic deposits; adyr [desert plains without sands but with soft ground] foothills consisting of Neogene and Lower- and Middle Quaternary deposits. On the basis of the photo image pattern it is possible to differentiate strongly, moderately and weakly dissected, undulating and flat surfaces. Flat and slightly undulating surfaces are interpreted on the basis of a geometrical or spotty pattern of cultivated landscapes; moderately dissected surfaces are discriminated on the basis of a jetlike pattern; well-dissected surfaces are discriminated from patterns form by adyr relief forms. Comparison of the interpreted photographs with "Meteor" photographs at 1:2,500,00 indicated that the latter reflect the nature of surface macrodissection. Their patterns are caused by relief megaforms associated with large geological structures. These photographs, at a larger scale, corresponded to the largest geomorphological regions. The photographs at 1,000,000, on the other hand, reflected lower-order structures. A two-page table lists the following types of photo image pattern revealed on these photographs: ribbon-banded; horseshoe-shaped; geometrical; fanlike, jetlike; feathered; spotty; spotty-jetlike; unstructured; parallel furrowed; plate; parallel banded; macrodendritic; microdendritic. Each of these patterns corresponds to specific geometrical characteristics, geomorphological characteristics, structural geology and genetic complex of deposits of various ages and definite regions. Figures 2; tables 1; references: 6 Russian. [25-5303]

UDC 551.46:629.7

USE OF SATELLITE DATA FOR STUDYING UPWELLING AND FRONTOGENESIS IN BALTIC SEA

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 85
(manuscript received 20 Apr 84) pp 12-19

BYCHKOVA, I. A., VIKTOROV, S. V. and VINOGRADOV, V. V., Leningrad Branch, State Oceanographic Institute

[Abstract] Experience in observing thermal fronts in the Baltic Sea revealed that their full study required organization of experiments using ships, aircraft and satellites. It would be useful to have a regular satellite IR survey backed up by land, sea and air observations. The authors examine this general problem in the specific example of observation of the frontal zone of the coastal upwelling along the eastern shore of the Baltic. This phenomenon is expressed in a coastal zone with a width of 15-25 km (in summer) and 30 km (in winter) and is characterized by a maximum variability of sea surface temperature. This coastal upwelling was detected on IR photographs taken from NOAA-7 and was attributed to an alongshore northeasterly transport of air masses lasting several days. The formation and further development of this coastal upwelling in July 1983 is discussed in detail. The reliability of satellite information is evaluated by a comparison with contact observations. The presented materials show that study of frontogenesis processes in the Baltic Sea, characterized by a synoptic time interval, require use of satellite data in the IR range having an adequate information yield for investigating small areas of a sea with a complex shoreline. The procedures outlined are of a general character and are applicable in the study of other hydrophysical fields. Figures 4; tables 1; references 8: 4 Russian, 4 Western.
[88-5303]

UDC 528.8.044

SPATIAL STRUCTURE OF PRECIPITATION ZONES ON RADAR IMAGES FROM SPACE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 85
(manuscript received 4 Dec 84) pp 20-28

PICHUGIN, A. P. and SPIRIDONOV, Yu. G., Radio Physics and Electronics Institute, Ukrainian Academy of Sciences, Khar'kov; State Scientific Research Center for the Study of Natural Resources, Moscow

[Abstract] In an earlier article (ISSLED. ZEMLI IZ KOSMOSA, No 6, pp 21-27, 1984) the authors examined the influence of precipitation on radar images of different types of earth's surface with different values of the effective scattering area (ESA) for a rain model vertically and horizontally homogeneous. The quantitative results obtained in the earlier study were suitable for estimates of the total ESA of the rain-surface system in cases

of extensive uniform precipitation. This same general problem has now been investigated for rain areas associated with convective clouds and the boundaries of frontal zones where precipitation intensity changes considerably over distances on the order of the characteristic dimensions of rain cells. The nature of the radar images for such rains is analyzed using two models of the spatial distribution of rain intensity: rectangular and Gaussian. The radar image of a precipitation zone with a rectangular distribution of rainfall intensity across the scanning band of a side-looking radar and the corresponding image in the case of a Gaussian distribution are fully discussed. This is illustrated using a specific image obtained using the side-looking radar aboard the "Cosmos-1500." It is shown that the spatial structure of precipitation zones on such images is easily determined. The results are a basis for developing methods for the radar sensing of precipitation from space and determining their spatial characteristics from radar images. Figures 6; references: 6 Russian.
[88-5303]

UDC 631.4:629.78

VARIABILITY OF COLOR COORDINATES OF SOME SOILS ACCORDING TO AIRCRAFT MEASUREMENT DATA

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 85 (manuscript received 26 Jul 84) pp 29-40

KONDRATYEV, K. Ya., KOZODEROV, V. V., FEDCHENKO, P. P., SOMOVA, S. M. and KARVOVSKAYA, L. B., Limnology Institute, USSR Academy of Sciences, Leningrad; Computer Mathematics Section, USSR Academy of Sciences, Moscow; All-Union Agrometeorology Scientific Research Institute, Obninsk; State Scientific Research Center for Study of Natural Resources, Moscow

[Abstract] The article describes a method for measuring the humus content in agricultural soils, applying techniques developed earlier (P. P. Fedchenko,, et al., ISSLED. ZEMLI IZ KOSMOSA, No 3, pp 77-82, 1984). In this method an aircraft carries a spectrometer used in measuring the spectral brightness coefficients (SBC) in the visible wavelength region which are then used in computing color coordinates quantitatively characterizing the humus content. Then the quantity of humus in soils is computed using a preconstructed calibration curve. Three types of soils were involved in this study: soddy-podzolic, gray forest and chernozem, located in a number of oblasts. Observations were made along measurement lines situated approximately 50 km apart for which SBC measurements were made. The spectral reflection curves were used in computing the color coordinates and determining the humus content at the measurementppoints. Observations were made from an AN-2 aircraft from a mean altitude of 100 m; measurements were made at a solar altitude greater than 40°. Photometric measurements of all the investigated soils were made twice (1973 and 1981). The analyzed data revealed that aircraft spectrophotometric measurements can be used successfully in studying the dynamics of soil humus content. However, the method is

suitable only for chernozems and possibly gray forest soils. Figures 5; tables 2; references: 16 Russian.
[88-5303]

UDC 634.4:629.78

EXPERIENCE IN MAPPING EARTH ON BASIS OF SPACE PHOTOINFORMATION

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 85 (manuscript received 8 Jun 84) pp 41-44

KULESHOV, L. N., State Land Resources Scientific Research Institute, Moscow

[Abstract] Experience in work on compilation of a series of specialized agricultural maps of the Kalmyk ASSR with the use of space photographs is generalized. Five maps were prepared: present status and use of land resources, types of sands, potential danger of appearance of processes of water and wind erosion, solonetz and solonetz-like soils and soils maps. Each of these maps is analyzed in detail. An evaluation of the information extracted from the space photographs was subjected to review by experts who rendered a subjective but highly accurate opinion. The different maps were ranked on the basis of effectiveness of use of space information, with the degree of use of direct and indirect interpretation criteria being determined. The highest percentage of use of direct interpretation criteria (~50%) is characteristic of the compilation of a map of the present status and use of agricultural land-use areas; the least use of direct and indirect criteria is in the compilation of soils maps (this is because the soil cover is not directly reflected on space photographs except in the case of intrazonal saline or swampy lands). In the first case the use of direct and indirect criteria is 70% (50-20); in the second case the use of direct and indirect criteria is 40% (10-30). In both cases the remaining information is taken from other sources. Therefore, as clearly demonstrated by the five types of maps considered, the importance of space photographs as information sources is different when compiling different classes of agricultural maps at 1:500,000. Tables 1; references: 9 Russian.
[88-5303]

UDC 528.77:550.814+629.78

GEOLOGICAL INFORMATION CONTENT OF MULTIZONAL PHOTOGRAPHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 85
(manuscript received 30 May 84) pp 45-51

YAKOVLEV, N. A. and SLUTSKAYA, S. G., Aerial Methods Laboratory, Aerogeologiya Geological Production Association, Leningrad

[Abstract] An evaluation is given for the several methods now in use for evaluating the geological information content of space photographs. When using these methods it is customary to give a qualitative or quantitative evaluation of the information content of images in different spectral zones for determining geological structure. These evaluations are used in recommending one or two universal channels for a particular territory or definite channels are indicated for different classes of geological features. All such methods share shortcomings in common. All are based on visual analysis of images--subjective perception. The features for whose images survey channels are recommended are considered in isolation, without regard for the other geological features surrounding them. When determining the information content of multizonal photographs they are compared against a geological map as a standard. All of these practices leave much to be desired. Accordingly, a different approach is proposed: multizonal photographs must be evaluated primarily on the basis of the effectiveness of reflection of spectral criteria. In this method in discriminating the feature and identifying it the problem will be solved more successfully the greater the contrast between the images of the discriminated feature and the background (adjacent features). Contrast can be used as the principal index of comparative information content of multizonal images obtained in different survey channels. Definite procedures are given for determining contrast. It is concluded that there are no universally informative survey channels for discriminating the images of geological features on the basis of spectral criteria. The geological information content of multizonal photographs as a whole and each survey channel separately can be evaluated only from the point of view of a specific problem. Tables 3; references 7: 6 Russian, 1 Western.
[88-5303]

UDC 528.77:550.814+629.78(517)

GEOLOGICAL INFORMATION CONTENT OF SPACE PHOTOGRAPHS OBTAINED IN DIFFERENT SPECTRAL RANGES IN COURSE OF 'GOBI-KHANGAI' EXPERIMENT (MUSHUGAY-GURVAN-BOGD TEST RANGE)

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 85 (manuscript received 17 Aug 84) pp 52-58

MAKAROV, V. I. and VOLCHKOVA, G. I., Geology Institute, USSR Academy of Sciences, Moscow

[Abstract] The "Gobi-Khangai" experiment was carried out from aboard the "Salyut-6"-"Soyuz-39" orbital complex by a Soviet-Mongolian crew in April 1981. A multizonal space photographic survey of the Mushugay-Khuduk region was made. This area is situated in the north-central part of the Gobi, directly to the east of Gurvan-Bogd Range in the Gobi Altai. Figure 1 is a full-page map of the interpreted space photographs. Also included in the article are the results obtained in an earlier (June 1973) survey of this same territory from the ERTS-1 satellite under different illumination conditions. The availability of data from two surveys made it possible to analyze photographic conditions more fully than would have been possible on the basis of the results of only one survey. The strengths and weaknesses of the two surveys are compared. The space photographs served as an excellent base for compiling a map of Quaternary deposits far exceeding the accuracy of maps compiled by surface methods. These photographs made possible a considerable upgrading of earlier published geological and tectonic maps. The comparative analysis of the geological content of space photographs obtained in different spectral ranges indicated that for visual interpretation under conditions similar to the Gobi Altai it is sufficient to have images in the spectral range 0.8-0.9 μm; the range 0.6-0.7 μm can be recommended as an additional range. A need for other ranges would arise only for obtaining synthesized images. Figures 2; references: 5 Russian.
[88-5303]

UDC 528.77:550.814+629.78(234.9)

TECTONIC INTERPRETATION OF RESULTS OF INTERPRETATION OF SPACE PHOTOGRAPHS OF THE CAUCASUS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 85
(manuscript received 4 Jul 84) pp 59-66

MIKHEYEV, G. A. and MAKAROVA, M. G., Priroda State Scientific Research and Production Center

[Abstract] An extensive literature has already been devoted to the possibilities of use of space photographs of the Caucasus for the geological study of that region. These materials and published results of such work are reviewed and integrated. A full-page map shows the location of lineaments and structures of the central (annular) type in the Caucasus region; this map is used in describing the interpreted photographs. It is concluded that in the formation of the present-day tectonic plan a definite role is played by faults of sublatitudinal and northwesterly directions forming disjunctive systems, longitudinal tectonic sutures bounding the principal structural-formation zones of the region. Dislocations with breaks in continuity but belonging to a single system were formed at the same time and under the same geotectonic conditions. Their degree of expression on space photographs in the form of systems of lineaments is determined by the degree of their influence on the formation of present-day morphostructures, that is, by activity in the neotectonic and most recent stages in development of this region. Structures of the central type in most cases constitute a surface reflection of vertical movements of polygonal basement blocks. But there are some structures of the central type whose nature remains unclarified. Space photograph analysis has shown that these materials are of great practical and scientific value for seismic research. The use of data from structural-tectonic interpretation of space photographs without question will make a major contribution to the study of seismicity in the Caucasus, facilitating the detection of seismically dangerous zones and intersection of disjunctive dislocations and evaluation of their current activity. Figures 1; references: 30 Russian.
[88-5303]

UDC 528.77+629.78:550.814+551.4(234.9)

PRINCIPAL PATTERNS OF MORPHOTECTONIC STRUCTURE OF EASTERN CAUCASUS DETECTED BY REMOTE SENSING METHOD

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 85 (manuscript received 20 Apr 84) pp 67-72

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[Abstract] On space photographs the Eastern Caucasus region in general is characterized by a quite nonuniform photoimage pattern attributable to sharp differences in the structure and strike of structural elements and a patchy composition of sedimentary strata. Against this background, interpretation of space photographs has made it possible to define major morphostructural zones, each having its own specific photoimage, pattern and phototone. In this article particular attention is devoted to the pattern of linear, arcuate and annular lineaments (a map of interpreted lineaments accompanies the text). The overwhelming majority of lines fit into two conjugate systems of lineaments: orthogonal and diagonal. Lineaments of the orthogonal system with general Caucasian and anti-Caucasus directions show up on the space photographs more clearly and are characterized by a great extent. Longitudinal lineaments, constituting more than 60% of all the interpreted lines, are predominant. Lineaments of an anti-Caucasus strike are more difficult to interpret because they are less clearly expressed in the relief. The diagonal system includes lineaments of northeasterly and northwesterly strikes. The latter are mostly short in length, playing an insignificant role in relief formation. The large lineaments for the most part coincide with faults detected by geological-geophysical methods. Many lineaments are not shown on existing tectonic maps and require field confirmation. Lineaments of each definite strike correspond to definite types of faults. The morphotectonic structure of the Eastern Caucasus as revealed by space photographs is entirely consistent with the theory of plate tectonics. Figures 2; references: 13 Russian.
[88-5303]

UDC 502.3:629.78

AUTOMATED SPECTRAL ANALYSIS OF DIMENSIONS AND DIRECTIONS OF STRUCTURAL ELEMENTS ON EARTH'S SURFACE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 85
(manuscript received 20 Jul 84) pp 73-80

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[Abstract] Ya. L. Ziman (ISSLED. ZEMLI IZ KOSMOSA, No 4, pp 81-84, 1980) proposed a method for a "structural-zonal" survey of the earth's surface from space. In this method the surface is viewed through a moving window containing N x N resolution elements, which is called an "operational unit." Some functionals, such as a matrix of integral relative energies in several zones of a Wiener spectrum (in a polar coordinate system), are computed for each operational unit. In this article the Ziman method is used in determining the sizes of tree crowns and discriminating the predominant directions of lineaments on photographs of the earth's surface. For each photograph fragment it is necessary to compute the functions C(m) and ℓ(n) whose values correspond to the part of Wiener spectrum energy falling within annular and slit filters respectively. The analysis was made for models of a forest and lineament structures with a uniform distribution (with respect to positions and sizes), and also for real photographs. Maps of crown size were constructed by correlation analysis of Wiener spectra. The discriminated directions are determined by the local maxima of the ℓ(n) function. A full algorithm is given for automated fragment-by-fragment spectral analysis of images. An analysis of models of images of structural elements is used in developing a method for retrieving the probability distribution function for tree crown sizes from the Fourier spectrum. Figures 4; references: 5 Russian.
[88-5303]

UDC 528.7.681.3

USE OF MATERIALS FROM LARGE-SCALE AERIAL PHOTOSURVEY OF FOREST IN AUTOMATED INTERPRETATION OF SPACE PHOTOGRAPHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 85
(manuscript received 4 Oct 84) pp 90-96

KUZENKOV, L. A., APARINOVA, N. A. and STARCHENKO, A. V., Lesproyekt All-Union Aerial Photographic Forest Management Association, Moscow

[Abstract] The problem of automated determination of evaluation indices for forested areas is discussed within the framework of the SNIMOK-DANNYYE

(Photograph-Data) technology described earlier (Ye. D. Bodanskiy, et al. (ISSLED. ZEMLI IZ KOSMOSA, No 1, pp 92-100, 1984; R. I. El'man, et al. (LESN. KHOZ-VO, No 6, pp 53-55, 1984). This method for the automated interpretation of space photographs is based on use of the statistical relationships between the evaluation indices of forested areas and the characteristics of the upper canopy. The statistical relationships are determined on a computer in the course of processing of data of a teaching sample. In the adopted technology, use is made of a regional approach in which the teaching samples are prepared for specific regions. In the preparation of the samples forested areas are also grouped using two main criteria: tree growth conditions and predominant species. The territory to be inventoried is divided into sectors in which tree growth conditions vary in a relatively small range. The automated system for processing of large-scale aerial photographs involves three principal operations: preliminary interpretation of photographs, interactive processing of photographs and data and determination of evaluation indices of typical plots using an electronic computer. A block diagram of interactive processing is used in a detailed discussion of this operation. The method was checked using 30 photographic control samples in larch forests in Central Yakutia with the photographs at a scale of 1:2,000. The following relative rms errors were found: reserve--14%, fullness--8%, age--14%, diameter--10%. Figures 1; references: 2 Russian.
[88-5303]

UDC 502:629.78

CHOICE OF CONDITIONS FOR AEROSPACE SURVEY IN VISIBLE SPECTRAL RANGE FOR DETERMINING ALBEDO OF OBJECT AND BACKGROUND

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 85 (manuscript received 11 Jun 84) pp 97-107

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[Abstract] A method for using the results of a stereoscopic survey for determining the absolute values of the reflective characteristics of an object and its background is proposed. The mathematical modeling of radiation transfer processes in the atmosphere and a physical analysis of this problem show that it is possible to select definite observation conditions, such as solar angle, sighting angle and spectral interval, when the principal factors determining the intensity of the radiation incident on the instrument entrance pupil are the reflective properties of the object and its background. In such a case the influence of the atmosphere on signal strength can be described using the mean threshold values of the parameters determining its state when the albedo of the observed natural formations exceeds 0.05-0.1. In the proposed stereoscopic method the relative error in determining albedo caused by the error in using the mean values of atmospheric parameters is 5-30% in a quite broad possible range of change of these parameters. It can be reduced considerably if

necessary data on the state of the atmosphere are available. The optical thickness of the atmosphere can be determined with good accuracy using the results of two-angle stereoscopic observation of light objects situated on a water surface. Taking into account uncertainty in water surface albedo, the relative error in determining total optical thickness under different natural conditions is 15-30%. Figures 6; references 15: 13 Russian, 2 Western.
[88-5303]

UDC 528.7:629.78

SYSTEM OF CRITERIA FOR ANALYSIS AND RECOGNITION OF IMAGES OF RANDOM SPATIAL TEXTURES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 85 (manuscript received 10 May 84) pp 108-110

BAZARSKIY, O. V. and KORZHIK, Yu. V.

[Abstract] Data on surface texture obtained in the form of a set of information criteria, as a result of compression of videoinformation, can be used in the routine analysis of images aboard a flight vehicle and in reducing the flow of information to earth which was registered during surveys with a high spatial resolution. The data transmitted to the earth can be analyzed using known textural criteria computed from matrices of spatial distribution of the gray tone, ensuring an adequately high percentage of correct identification of images (up to 90%). However, this requires a great number of computation operations, proportional to the number of resolution elements in the image, and the need for technically complex computers. For this reason the authors have developed a system of criteria for the analysis and identification of the images of random spatial textures which can be used with a very simple computer. On the basis of a matrix of primary criteria P_{ij} it is possible to form a system of $L = 3(1+2M)$ criteria: A_i, C_i, D_i. The choice of the number of threshold levels M is dependent on the statistical properties of the analyzed textural sectors on the surface. It is adequate that $M = 2$ for images fo random textures having a normal law of distribution of optical densities. A total of $L = 15$ criteria are computed, which requires only 105 computation operations, which is several orders of magnitude less than in known systems of criteria. A block diagram of the method for the formation of criteria and an example of application of the method are given. Analysis of the criteria revealed that the clusters formed in criterion space for different classes of textural surfaces are characterized by a very high separability (the total degree of uncertainty for each cluster was close to zero). The isotropicity coefficient for textures of the sand type was $A = 0.98$ and for the sea

surface it was A = 0.55. Using the proposed system of criteria a high probability of a correct classification of texture of the earth's surface was obtained (P = 99%). Figures 1; references 7: 4 Russian, 3 Western. [88-5303]

UDC 551.509.313.001.527

RATIONALIZATION OF SYSTEM FOR ACQUISITION OF OZONE REMOTE MEASUREMENT DATA IN NORTHERN HEMISPHERE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 85 (manuscript received 5 Apr 84) pp 10-16

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[Abstract] The results of studies of schemes for the collection of remote sensing data on ozone have indicated a considerable informational nonuniformity of different regions both in the entire northern hemisphere and within the limits of individual latitude zones. (This nonuniformity becomes even greater when measurements made at stations in the surface ozonometric network are taken into account.) In order to improve this situation the authors give the results of optimization of the arrangement of the trajectories of artificial earth satellites and their segments within the limits of individual latitude zones in the northern hemisphere. The minimizing the rms error in analysis of the field of total ozone content in the northern hemisphere was used as the optimization criterion. The use of the method for optimizing the spatial scheme for the collection of data described earlier (A. I. Belyavskiy, et al., ISSLED, ZEMLI IZ KOSMOSA, No 3, pp 3-13, 1984) in the interpretation of satellite data on the total content of ozone in the northern hemisphere is reviewed and discussed. Cases of analysis of the ozone in the northern hemisphere is reviewed and discussed. Cases of analysis of the ozone field within the limits of three latitude zones (polar, middle latitude, tropical) and for the entire northern hemisphere are examined. Values of indices of the effectiveness of optimization of IR and UV remote sensing systems are obtained, as well as estimates of accuracy of the analysis in the principal latitude zones. The described optimization of the remote sensing scheme makes it possible to achieve an economy of measurement system resources by 30-70% in different situations. The use of the proposed optimization procedure is most effective in a case when the information contribution of the surface ozonometric network is taken into account in the analysis of the ozone field. There are informational relationships during summer between IR measurements in the middle and low latitudes and also between UV measurements in the high and middle latitudes. Figures 3; references 7: 5 Russian, 2 Western. [74-5303]

UDC 551.576.2

ANNUAL VARIATION OF CLOUD QUANTITY AND ALBEDO

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 85
(manuscript received 5 Jul 84) pp 17-22

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[Abstract] In studying climate it is important to determine whether the albedo effect or the greenhouse effect is dominant on a global scale. This requires a precise knowledge of cloud cover distribution over the earth. The author accordingly made a comparison of different climatological evaluations of cloud cover quantity in order to ascertain the general patterns in its global variation and estimate the reliability of determination of the albedo effect of cloud cover on the basis of a comparison of data on cloud cover with albedo of the earth-atmosphere system obtained from satellite experiments. A wide range of published data was used in this analysis. The comparison indicated that in evaluating the global albedo effect of cloud cover quantity it is necessary to study the joint distribution of the quantity and thickness of clouds with large averaging scales. It was found that the most thorough published studies on the quantity of cloud cover give a qualitative consistency in the annual variation only for the northern hemisphere. Comparison of the annual albedo of the earth-atmosphere system and the albedo of cloud cover in the tropical zone revealed that the albedo of cloud cover is dependent on its quantity. However, any evaluation of the global albedo effect on the assumption of the nondependence of the quantity and albedo of cloud cover must be considered preliminary.
Figures 2; tables 1; references 21: 6 Russian, 15 Western.
[74-5303]

UDC 528.88:551.24

METHODS FOR STUDYING RECENT TECTONICS USING MATERIALS FROM REMOTE AND SURFACE DATA

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 85
(manuscript received 18 Jun 84) pp 32-38

FREYDLIN, A. A., FARRAKHOV, Ye. G. and VOLCHEGURSKIY, L. F., Aerogeologiya
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[Abstract] A combined analysis of remote and surface information was used in studying manifestations of neotectonics. The first step was a compilation of maps based on structural and geoindication interpretation of small-scale photographs at the regional level. Large linear, concentric and areal elements were defined. Regionalization maps were prepared. The area studied was divided into four zones corresponding to the principal tectonic

blocks. Linear elements were automatically interpreted with their separation by orientation into eight directions. Original tectonic maps were compiled on which it was possible to define systems of neotectonic anomalies. Subsequent work was carried out by an enlargement of the scales of initial materials from 1:1,000,000 to 1:50,000. The photointerpretation was accompanied by an analysis of relief and the erosional network. Data from geophysical research and drilling were used in clarifying the nature of the anomalous objects. All this was supplemented by geological interpretation of seismic profiling sections and logging diagrams. The gravity and magnetic fields were studied. These and other data were incorporated in a computer data bank. On the basis of all this work it was possible to determine the interrelationships of features interpreted on space photographs and neotectonically active zones, their inheritance and as a result, the possiblities of predicting the propsects of some structures for petroleum and gas within the limits of the Eastern Caspian Basin. It was possible to ascertain the patterns of location and structure of zones of the most recent deformations, the interrelationship of interpreted relief elements and deep tectonic characteristics of the region, the tectonic and neotectonic relationships of petroleum deposits in the region and the role of tectonic processes in the formation of blown sands in the Caspian region. Figures 2; references: 3 Russian. [74-5303]

UDC 528.77:553.98

POSSIBILITIES OF USE OF REMOTE METHODS FOR INCREASING EFFICIENCY OF PETROLEUM AND GAS EXPLORATION WORK

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 85 (manuscript received 5 May 83, after revision 30 May 84) pp 39-46

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[Abstract] Space photoanomalies corresponding to structures promising for petroleum and gas are usually situated within the limits of anitclinal zones of petroleum and gas accumulation. Many buried anticlines in which petroleum and gas deposits have been discovered stand out as tonal photoanomalies in the near-IR spectral zone where the petroleum deposits "show through" as ovals of a darker tone and gas deposits stand out in a lighter tone. Within the limits of the South Tajik Depression, for example, there are a number of discordant lineaments whose strike is not consistent with the most recent folding (a full-page tectonic map of this area accompanies the text). There are interpreted on space photographs in the form of elements of a darker phototone. Some of the most important features are sublatitudinal lineaments which can be identified with deep ancient faults which exert a great influence on the conditions for the formation and preservation of petroleum and gas deposits. The combining of the results of traditional research methods and materials obtained by remote methods made it possible to define a number of promising regions which are

recommended for further petroleum and gas exploration work. (These are clearly designated on the tectonic map.) These promising regions are described in detail and some space photoanomalies within their limits are analyzed. Figures 3; references: 11 Russian.
[74-5303]

UDC 551.49:62°.78

DETERMINING WATER SURFACES IN NORTHWESTERN BOHEMIA FROM SATELLITE DATA

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 85 (manuscript received 7 Jun 83) pp 47-51

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[Abstract] Satellite data were used in determining surface water formations in the territory of Czechoslovakia. The aritcle gives an analysis of a photograph of northwestern Bohemia which is characterized by a well-expressed dynamics of surface changes attributable to economic activity. The photograph was taken from the "Landsate" satellite on 30 June 1978. One of the manifestations of these changes is the appearance or disappearance of some water bodies in a relatively short time interval which necessitates corrections to topographic and geographic maps. A test range with an area of about 600 km^2 was defined in the studied area. This is a mining region where open pits and mine tailings become filled or flooded with water. The water surfaces have different extents and configurations determined by the nature of the depression, hydrogeological and climatic conditions. The initial form of the information used in the study was the spectral characteristic of the water surface. The information used in the classification of water surfaces was from a single spectral channel for the near-IR region. A total of about 135,000 brightness values were obtained for the test range. Some 96 water surfaces of different extent were detected. These image data were compared with water surfaces on topographic maps at 1:25,000 and 1:50,000 and water surfaces on black-and-white panchromatic aerial photographs at 1:20,000. It was possible to make reliable identification of water bodies with an area greater than 1 hectare. The total surface area of the water bodies in the region was 461.5 hectares, of which 458 hectares were correctly determined (98.5%). The satellite photograph method is particularly useful in studying such unstable and newly appearing water surfaces. Figures 2; references: 1 Russian.
[74-5303]

UDC 502:528.77:631.4:629.78.551

COMPREHENSIVE DESERTIFICATION MAPS AND METHODOLOGY FOR THEIR COMPILATION USING SPACE PHOTOGRAPHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 85
(manuscript received 2 Apr 84) pp 52-59

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[Abstract] As a result of the desertification process, between 50,000 and 70,000 squire kilometers of land in different parts of the world are becoming virtually useless each year. The FAO is working on a project for contending with this process. The Desert Institute, Turkmen Academy of Sciences, is participating in this work. The objective is compilation of a world desertification map; it will convey information on the state of the environment which will be useful in planning measures for safeguarding the desert environment. In the first stage of the project Turkmen specialists are defining regional desertification indicators and criteria. This article describes the methodology being used in compiling small-scale desertification maps from space photographs. Among the criteria used in this work are: background level (BL), present status (PS), rate of desertification (RD), internal danger of desertification (IDD), influence of animals on environment (EIA), degree of anthropogenic influence (DAI) and total danger of desertification (TDD). The latter is determined using the formula

$$TDD = PS + RD + IDD + EIA + DAI.$$

The total danger of desertification is a prognostic characteristic revealing the tendency to development of the process in the future. The principal desertification processes are degradation of the vegetation cover, wind erosion, water erosion, technogenic desertification and salinization of soils. All these are considered in the exposition of the detailed methodology used at the Turkmen Desert Institute in compiling desertification maps. Important tables give the criteria used in evaluating vegetation cover degradation and criteria used in evaluating wind and water erosion and technogenic desertification. Tables 5; references 12: 7 Russian, 5 Western. [74-5303]

UDC 631.47+581.5:629.78

USE OF SPACE METHODS FOR STUDYING SALINE SOILS AND SOLONCHAKS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 85
(manuscript received 19 Apr 84) pp 60-65

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[Abstract] There is a spatial-temporal variability of saline lands which requires a constant inventory of their area and state and a systematic revision and correction of soil maps. A high percentage of the lands in the Azerbaijan SSR falls in this category. For example, there are 98,000 hectares of solonchaks with a salt content of more than 3%, 540,000 hectares of very saline soils with from 2 to 3% salts and very significant areas with lesser salt contents (1-2%, 0.5-1%). Experience in the USSR and aboard has already demonstrated the effectiveness of aerospace methods for investigating and monitoring saline lands. Specific work along these lines has been carried out in test areas in the Azerbaijan SSR. This article describes such work in the Adzhinourskaya steppe. Key sectors have been covered by detailed geobotanical surveys on the ground, taking into account the seasonal variability of the vegetation cover. After preparation of a detailed map of the key area on the basis of aerial photographs and ground field work it was possible to proceed to interpretation and mapping on the basis of space phtotographs. The 1972 space photographs used were from the "Landsat" satellite in four spectral zones. It was found that the most effective spectral zones for the mapping of saline soils are 0.6-0.7 and 0.8-1.1 μm. The use of maps prepared from space photographs greatly increased the detail of the maps in comparison with those prepared by traditional methods, clearly revealing the natural pattern of soil and vegetation groupings, increasing the number of varieties of saline and swampy soils and solonchaks by a factor 2-3. Mapping was also based on multizonal photographs obtained in 1976 using the MKF-6 camera on "Soyuz-22." These photographs made possible clear definition of six types of landscapes, each corresponding to definite soil groups. The outlines of individual soil areas discriminated on the basis of phototone and color fully corresponded to the results of field mapping and data from physicochemical analysis. It was concluded that in Azerbaijan such work is best accomplished using multizonal photographs taken in July-August at wavelengths 0.5-0.6 and 0.6-0.7 μm. Figures 3; references 16: 14 Russian, 2 Western.
[74-5303]

UDC 528.813+631.1

DETERMINING SOIL MOISTURE CONTENT BY MICROWAVE RADIOMETRY METHOD USING A PRIORI INFORMATION

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 85 (manuscript received 27 Jan 84) pp 73-87

REUTOV, Ye. A. and SHUTKO, A. M., Radio Engineering and Electronics Institute, USSR Academy of Sciences, Moscow

[Abstract] Theoretical and experimental studies of the microwave emission characteristics of soils with nonuniform vertical moistening were carried out, making it possible, within the framework of the selected models, to derive expressions relating the change in the reflection coefficient and the parameters of the dielectric constant profile (or corresponding soil moisture content values) for different types of distributions. A comparison of the computed and experimental data made possible a qualitative evaluation of the theoretical results. It was found that the radiation-moisture content dependence obtained for uniformly moistened soils is applicable for determining soil moisture content in some layer of nonuniformly moistened soils. It was possible to estimate the thickness of this layer, which is dependent on the moisture content gradient, moisture content of the surface soil layer and wavelength; it averages 10-40 cm. It was also possible to estimate the response of the spectral radiobrightness contrast to the moisture content gradient in the surface soil layer and the error in determining the moisture content gradient on the basis of the results of spectral microwave radiometric measurements. There is a great efficiency in the joint use of spectral microwave radiometric measurements and additional information on the hydrophysical properties of soils for estimating the parameters of the moisture content profile and total moisture content in the meter soil layer. The method affords real possibilities for routine collection of data on moisture reserves in the meter soil layer. Figures 13; tables 3; references 17: 12 Russian, 5 Western.
[74-5303]

UDC 528.873.044.1:631.44

RADAR MAPPING OF MOISTURE CONTENT OF OPEN SOILS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 85 (manuscript received111 Jan 84) pp 88-93

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[Abstract] Radar mapping of the moisture content of open soils was carried out using a "Toros" airborne side-looking radar set operating at a wavelength of 2.5 cm with horizontal polarization of the radiated and received signals.

The radar survey was made over a radiophysical test range which was occupied by 15 farms. The radar survey of the area was accompanied by simultaneous surface studies of the soil and vegetation cover. This included measurement of moisture content in some fields at the horizons 0-5 and 5-10 cm both on open soils and on soils covered by vegetation. Irrigated fields were surveyed in September and unirrigated lands in December. The moisture content in the upper layer of the open soil in both irrigated and unirrigated areas was in the range 9-30% by weight. The linear resolution of the radar along the surface was 50-70 m (after automatic processing image resolution worsened to 60-100 m). Automated processing involved element-by-element reduction of the optical density of the negative radar image to digital form, its registry on magnetic tape, computer image input and processing and color output of the image to a display. During processing an instrumental correction was made and the image was averaged element-by-element for reduction of the noise level. It was found that direct and remote radar measurements give close results. In both irrigated and unirrigated areas the local ground-determined moisture contents of the soils did not differ by more than 2% by weight in the range of moisture content changes from 9 to 30%. Figures 5; tables 1; references 5: 4 Russian, 1 Western.
[74-5303]

UDC 528.7:681.3

DISCRIMINATING HOMOGENEOUS REGIONS WITH INCOMPLETE BOUNDARIES ON IMAGE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 85
(manuscript received 27 Jan 84) pp 94-102

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[Abstract] Automated interpretation of aerospace photographs in many cases requires an image segmentation procedure, but this has rarely proven successful in the solution of geological problems: the contrast with geological regions usually is insignificantly less than the contrast at the boundary between them. Indeed, the absence of contrast even on small segments of the boundaries makes it impossible to use segmentation methods. The strategy of a method for solving this problem is formulated. In the choice of a procedure for discriminating boundary elements the point of departure is a minimizing of the number of spurious boundary elements and in the subsequent analysis the emphasis is on elimination of the gaps in the boundaries. Solution of the problem requires solution of three problems: how to detect a quasiclosed boundary (boundary with gaps), what boundary elements constitute a quasiclosed boundary and how to find the region which these elements separate. A method was developed for checking relative closure. For this purpose a "depth" parameter is introduced which for each image element determines the distance to the nearest boundary element. This parameter indicates how "deep" this element is situated within the homogeneous region and how far it is from the boundaries. All the boundary elements can be visualized as synchronous sources of a wave propagating in the image plane

and elements of an identical depth correspond to lines of equal phase. This "depth" parameter corresponds to the "distance transform" concept which is the basis for many operations of the "wave" type. The proposed segmentation algorithm can be assigned to operations of the "wave propgation" type. Application of the algorithm is illustrated in the defining of photoanomalies corresponding to areas of intrusive rocks. Figures 2; references 6: 2 Russian, 5 Western.
[74-5303]

UDC 681.32:518.528

SEGMENTATION OF HALF-TONE AEROSPACE IMAGES BY LEVEL LINES METHOD

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 85 (manuscript received 5 Dec 83, after revision 14 Aug 84) pp 103-112

MINSKIY, D. Ye. and FEYGIN, M. M., Specialized Division of Engineering Field Work and Research, Soyuzgiprovodkhoz Institute, Moscow

[Abstract] Segmentation, the discrimination of the boundaries of represented features, is one of the most important tasks in the interpretation of aerospace videoinformation. The authors describe a method for automatic segmentation of half-tone images based on the search for and indication of characteristic image brightness level lines. Various approaches to solution of the automatic segmentation method have been published; these are reviewed, with an assessment of their merits and shortcomings. The proposed method involves search for points with sufficiently great contrast on the image and the drawing from the selected point of a line separating features in such a way that all the elements lying to the left of the line and adjacent to it are characterized by a darker tone than those lying to the right. The choice of the brightness level line as a boundary (edge detection) has a physically sound basis. A mathematical model of a continuous scalar field is presented which is used in the theoretical development of the method. This is followed by a description of an algorithm for application of this method and a program for use in practical automated preliminary interpretation of aerospace information. Such work is illustrated in a specific example. Figures 4; references 15: 8 Russian, 7 Western.
[74-5303]

UDC 528.711.714.1

USE OF A PRIORI EVALUATION OF CONDITIONS FOR OBSERVING EARTH'S SURFACE FROM SPACE FOR EFFECTIVE CHOICE OF TIME FOR EXECUTING SURVEY

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 85
(manuscript received 1 Aug 84) pp 113-117

KAPITONOVA, N. V. and LUKASHEVICH, Ye. L., Priroda State Scientific Research and Production Center

[Abstract] Adequate study has been made of the motion of space vehicles for studying the earth's natural resources, such as the nominal parameters of their working orbits, but a weak link which remains is the uncertainty in choice of the initial orientation of the orbital plane relative to the direction to the sun. This orientation is determined by the angle $\tau = \alpha - \Omega$, where α is the right ascension of the sun on the initial date of the survey, Ω is the longitude of the ascending node of the space vehicle orbit, unambiguously related to the illumination conditions for the earth's surface along the flight trajectory. A method has been developed for determining a rational Ω value which would make possible the most complete satisfaction of requirements on solar altitude $h_\odot$ in surveys of different regions, taking their meteorological and climatic characteristics into account. For this purpose the earth's surface which is to be photographed from a circular orbit from a satellite with a specific inclination is broken down into regions with characteristic climatic conditions. These regions are approximated by spherical quadrilaterals whose eastern and western boundaries are formed by the arcs of great circles situated along the space vehicle flight trajectories. The northern and southern boundaries are formed by parallels, breaking the photographed area down into latitude zones through which the vehicle passes in identical time intervals. With such a working base it is possible, for example, to estimate the possibility of surveying some j-th zone with probable cloud cover (the most important factor governing the success of such a survey) taken into account. The article outlines the specific steps and gives the required formulas for ascertaining a rational value of the sought-for parameter, the longitude of the ascending node. This Ω value will ensure satisfaction of the maximum possible number of requirements on illumination of those zones for which the date of conducting of surveys coincides with the period of most probable cloud cover minimum. References 4: 3 Russian, 1 Western.
[74-5303]

UDC 551.46:629.78

AEROSPACE OBSERVATIONS OF ADVECTIVE-EDDY FORMATIONS IN CENTRAL BALTIC SEA

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, Jan-Feb 85
(manuscript received 20 Apr 84) pp 118-122

BYCHKOVA, I. A., VIKTOROV, S. V., VINOGRADOV, V. V., LOSINSKIY, V. N. and BROSIN, Kh. Yu., Leningrad Division, State Oceanographic Institute, Leningrad; Marine Sciences Institute, GDR Academy of Sciences, Rostok-Warnemünde

[Abstract] Under definite conditions eddy movements occurring at different depths in the Baltic Sea can be manifested in the form of surface nonuniformities of the temperature field and brightness of the sea surface. These nonuniformities are registered by satellite instruments operating in the visible and IR ranges. Considering the role of the wind in dynamic processes in the Baltic, there is probably a high frequency of recurrence of formation of local advective-eddy fronts of synoptic scales in the surface layer. Study of such phenomena was the objective of the second USSR-GDR Complex Subsatellite Experiment. The research ship "A. von Humboldt" during the first half of June 1983 was in a hydrological test range in the central part of the sea, each day occupying 8-9 stations. Satellite information in the IR range was received simultaneously. The observations revealed that regardless of wind conditions a correlation between radiation temperatures obtained from both a satellite and aircraft and shipboard thermodynamic temperatures can be traced to a depth of 17 m. At a depth of 35-40 m the correlation coefficient becomes negative, corresponding to the formation of a countercurrent in the Ekman layer. Accordingly, sea surface temperature maps obtained in the Baltic Sea using satellite data can be used in tracking drift currents. The article, as an example, discusses the three-dimensional thermal structure in the test range for 7 June on the basis of satellite and ship data. Figures 3; references 7: 4 Russian, 3 Western.
[74-5303]

UDC 528.2/.3

FEATURES IN ALLOWANCE FOR ATMOSPHERIC INFLUENCE IN VERY LONG BASELINE RADIOINTERFEROMETRY

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOS"YEMKA in Russian No 5, Sep-Oct 84 (manuscript received 30 Dec 81) pp 3-8

ZABOLOTNYY, N. S., docent, candidate of technical sciences, and SHANUROV, G. A., docent, candidate of technical sciences, Moscow Order of Lenin Institute of Geodetic, Aerial Mapping and Cartographic Engineers

[Abstract] Space methods are playing an ever-increasing role in the solution of geodetic problems; this includes the very long baseline radiointerferometry method. The instrumental errors are on the order of centimeters and this accuracy may soon be increased by an order of magnitude. The measurement accuracy will be limited by the influence of the atmosphere and conditions for the propagation of electromagnetic waves. This influence is manifested in a change in the velocity of propagation and phase shift. These two phenomena were examined because they exert an influence on the measurement results in the most promising space geodesy radio methods: very long base radiointerferometry and the Doppler method for observing artificial earth satellites. In order to solve these problems the authors propose models for the effective determination of the refractive index. These models are proposed for eavluating the time delays and frequency shifts of signals in the troposphere and ionosphere for different radio wave propagation conditions; corresponding formulas are presented. It is shown that distortions from the influence of the atmosphere in the measured ranges, range differences and Doppler frequency are so great that they must be taken into account in any geodetic determinations. Varieties of a biexponential model of the atmosphere are proposed for determining the refractive index. Figures 5; tables 2; references 6: 4 Russian, 2 Western.
[49-5303]

UDC 528.225:620.783

DETERMINING GEOCENTRIC GRAVITATIONAL CONSTANT BY SPACE GEODESY METHODS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOS"YEMKA in Russian No 5, Sep-Oct 84 (manuscript received 15 Feb 84) pp 46-53

PLAKHOV, Yu. V., professor, doctor of technical sciences, and PARAMZIN, A. V., graduate student, Moscow Order of Lenin Institute of Geodetic, Aerial Mapping and Cartographic Engineers

[Abstract] The authors examine the possibility of an independent determination of the preliminary value of a correction Δ_{μ_0} to the accepted value of

the geocentric gravitational constant μ and the orbital semimajor axis a of a satellite on the basis of suitably modified equations of the space geodesy orbital method using the minimum necessary number of observations. The equations employed in this investigation are not intended for solution of other space geodesy problems. Repeated studies have shown that the accepted μ value cannot be determined more precisely by traditional correction methods. It is deemed essential that a number of conditions be introduced if the μ value is to be further refined. Seven such conditions are stipulated. The approach outlined was successful. The following are important aspects of this approach: use of a specialized satellite (with respect to inclination and orbital eccentricity); use of the effect of accumulation of error in orbit; performance of synchronous measurements of distances and directions to an artificial earth satellite from a current point in one and the same orbital segments. It is desirable that the refinement of μ be preceded by refinement of the geopotential parameters, especially the zonal parameters, from perturbations of artificial earth satellite orbits since that method has a low sensitivity to variations of the μ value. It is shown that artificial satellites in near-polar, almost circular orbits are most suitable for solution of this problem. References: 10 Russian.
[49-5303]

UDC 528.721.113:528.716

DETERMINING ELEMENTS OF OUTER ORIENTATION OF AEROSPACE PHOTOGRAPHS IN REMOTE STUDY OF DYNAMIC PROCESSES AND PHENOMENA

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOS"YEMKA in Russian No 5, Sep-Oct 84 (manuscript received 16 Mar 84) pp 66-70

DUBINOVSKIY, V. B., professor, doctor of technical sciences, and MOROZOV, A. A., graduate student, Moscow Order of Lenin Institute of Geodetic, Aerial Mapping and Cartographic Engineers

[Abstract] A method is proposed for determining the elements of outer orientation of a new flight on the basis of photographs of an old survey for which the elements of outer orientation are known. In the proposed method, two photographs of an old survey whose elements of outer orientation are known are used together with a photograph from a new flight. By forming two stereopairs from a photograph of the new flight and one of the photographs from the old flight it is possible to determine the angular elements of outer orientation of the new photograph, the direction angles and angles of inclination of the photographic bases, and then, by solution of direct intersection using data from a pair of old photographs and the angular elements of outer orientation of a photograph from the new flight. The use of the elements of outer orientation of photographs of the old survey as control data completely precludes the need for determining reference points. The use of this method for constructing photogrammetric networks when revising topographic maps, in comparison with existing photogrammetric procedures, ensures an increase in the accuracy in constructing such networks. This

method increases accuracy in determining terrain point coordinates due to a more precise determination of the control data (the elements of outer orientation of photographs) by using the results of highly precise measurements of the coordinates of a large number of photograph points in the stage of determination of the elements of outer orientation and is superior to office identification of points on the initial geodetic base on aerial photographs, deterination of control points from a revised map of photogrammetric insertion of field points from an old survey into aerial photographs of a new flight. Moreover, it is possible to use the very same initial control data in the form of control aerial photographs in each subsequent revision of a topographic map. Figures 2; references: 4 Russian.
[49-5303]

UDC 528.721:516

PREDICTING COORDINATE ERRORS OF PHOTOGRAPH POINTS

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: FEODEZIYA I AEROFOTOS"YEMKA in Russian No 5, Sep-Oct 84 (manuscript received 20 Sep 82) pp 70-75

YELYUSHKIN, V. G., engineer, and PRONIN, B. V., candidate of technical sciences

[Abstract] The possibilities of increasing the accuracy in the processing of individual space photographs by predicting coordinates at any point on the basis of the values of errors at control points are reevaluated. The findings are applicable to all images obtained by remote sensing techniques (radar, infrared, television, etc.). A necessary condition for the proposed procedures is the presence of residual errors at the control points after preliminary processing by the least squares method. This prediction method in its practical use has the advantage that, in comparison with the known prediction method, instead of a preliminary determination of the correlation function of errors it is only necessary to know its analytical expression. The parameters entering into it are selected in such a way as to minimize the prediction error and the known values of the errors at a certain percentage of control points. It is shown that the coordinate errors of points on radar photographs form a nonstationary random field and in their prediction it is desirable that the correlation function of errors be approximated by an expression derived in this article because the maximum gain in prediction accuracy is thereby attained. The described method for linear prediction of the coordinate errors of points on radar photographs makes it possible to increase the accuracy in their processing by 16-36%. In the first approximation the accuracy gain is not dependent on local relief. Figures 1; tables 1; references: 6 Russian.
[49-5303]

UDC 528.71

INFLUENCE OF CARRIER ORIENTATION ERRORS ON IMAGE MOTION IN PHOTOGRAPHY FROM MOVING OBJECT

Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEODEZIYA I AEROFOTOS"YEMKA in Russian No 5, Sep-Oct 84 (manuscript received 8 Apr 80) pp 75-80

MILLER, B. M., candidate of physical and mathematical sciences, and FEDCHENKO, G. I., engineer

[Abstract] Image motion frequently plays a decisive role in photography from moving objects because it results in image degradation. One of the causative factors is the influence of errors in the orientation system, a subject about which little has been published. D. A. Kawachi (PHOTOGRAMMETRIC ENGINEERING, Vol 31, 1965) derived expressions for image motion rates caused by rotations of a vehicle with constant angular velocities with zero errors in orientation angles, but no expressions were derived for the additional rates caused by deviation of the vehicle coordinate system from a nominal position. Accordingly, the authors obtained evaluations of the influence of this type of error on image motion for any optical system. The basis for this work was the expressions for image motion obtained by B. M. Miller, et al. in IZV. VUZov: GEODEZIYA I AEROFOTOS"YEMKA, No 4, 1984. The proposed method is based on numerical methods and use of an electronic computer, which makes it possible to evaluate the stochastic characteristics of image motion over the entire frame field. The algorithm proposed in the 1984 article can also be used in evaluating the influence of errors in the orientation and stabilization system. This problem has now been rectified and the algorithm is based on the assumption of smallness of the errors. The method is based on a determination of the partial derivatives for the image motion rate field. The algorithm for determining influence coefficients is used jointly with the algorithm for computing the residual rates of image motion, thereby reducing computer time in the stochastic modeling of system operation. The application of the method is illustrated in an evaluation of the influence of orientation errors on image motion in panoramic photography.
References 3: 2 Russian, 1 Western.
[49-5303]

UDC 639.2/3:629.78

POSSIBILITY OF USING SATELLITE IR-INFORMATION FOR OCEANOLOGICAL RESEARCH

Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA: GEOLOGIYA, GEOGRAFIYA in Russian No 14, Issue 2, Jun 85 (manuscript received 16 Nov 83) pp 93-95

LIKHACHEV, I. V. and MICHURIN, A. N., Leningrad State University

[Abstract] Although there are real possibilities for obtaining satellite information (SI) for considerable expanses of the ocean, there are still no

possibilities for its routine processing. This dictates a need for storing SI for its subsequent processing at on-shore computation centers. In exploring this problem, a "Kapsi" receiving station was used in determining the possibility of reception and registry of SI on an intermediate magnetic carrier with subsequent input of the SI into a computer. It was found that an ordinary magnetic recorder tape can be used as a magnetic carrier. It was taken into account that the magnetic recorder had to ensure the necessary quality of the record without significant distortions. Distortions can be caused by: inadequate passband of recorder (amplitude-frequency distortions); instability of rate of tape movement; tape stretching. An effective method was developed for SI registry on magnetic tape. On one track of an ordinary stereophonic recorder having adequately high frequency characteristics and relatively low detonation there is registry of a satellite signal of a subcarrier frequency from the receiver output; the second track is used in registering a pulsed signal from a highly stable quartz oscillator used in data processing as a synchronizable signal determining the discreteness of SI digital readings. In this way, with relatively high amplitude-frequency characteristics of the magnetic recorder, the influence of detonation, instability of rate of movement and tape stretching can be neglected. The next stage in data preparation is the input of satellite data registered on magnetic tape into a computer memory, with discrimination of IR-radiometer data from the total volume of data. The proposed processing system is described (a block diagram is included). This system allows a virtually loss-free delivery of satellite data to the computer input. Figures 1; references: 2 Russian.
[107-5303]

UDC 528.8

DYNAMIC AEROSPACE SENSING (CONTENT, PROBLEMS, FIELD OF APPLICABILITY)

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 5: GEOGRAFIYA in Russian
No 4, Jul-Aug 85 (manuscript received 5 Oct 84) pp 7-13

KNIZHNIKOV, Yu. F.

[Abstract] Dynamic aerospace sensing is defined as a modern methodology for studying temporal dynamics with the use of aerospace methods. Direct and indirect variants are distinguished, being based on use of a series of photographs taken at different times or on use of individual photographs. Direct methods for the most part supply quantitative information on dynamics, its intensity and rate. The spatial and temporal coverage of the phenomena which can be studied using photographs taken at different times is different. Whereas there are virtually no spatial limitations, the duration of the temporal coverage does not exceed the 11-year, or possibly the Brückner cycle of natural changes. The indirect methods make it possible to study the temporal and spatial dynamics in a case when it is reflected in the external appearance of objects which are indicators of dynamics. The interval of temporal analysis is virtually unlimited. The range of features, phenomena and processes whose dynamics can be studied by aerospace methods is extremely

broad and the range of scales is from detailed to global. Nevertheless, they are all based on common methodological principles ensuring a comparability of the results. In the different geographic branches the level and breadth of development of such studies varies at present. They are particularly promising in meteorology, oceanology, glaciology and hydrology, which deal with mobile objects and phenomena. However, the other geographical sciences, especially dealing with the socioeconomic aspects of geography, can profit greatly from application of the method. Another highly important merit of the method is that it can be applied in the prediction of spatial-temporal changes of features, phenomena and processes; it is useful in expert evaluations, extrapolation and modeling. References: 17 Russian.
[113-5303]

UDC [528.72:621.397].001

PRINCIPAL PHOTOGRAMMETRIC DEPENDENCES IN PROCESSING OF RADAR SURVEY MATERIALS

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 9, Sep 84 pp 38-36

TYUFLIN, Yu. S.

[Abstract] In the photogrammetric processing of the materials from radar mapping of the Venusian surface from the "Venera-15" and "Venera-16," which carried side-looking radars, it is necessary to have mathematical expressions for accomplishing a coordinate referencing of the radar survey materials, for constructing a control network on the planet, for compiling photomaps of its surface and other procedures. This is dictated by the fact that the geometrical principles involved differ from those applicable to photographic and TV images. In the case of radar images it is essential to determine the spatial position of each projecting ray; a radar image can be formed only after spatial determination of the position of the radar rays at the current moments in time. This article gives the full derivation of the required expressions. These are derived using a feature-centered orbital coordinate system with its origin at the center of mass of the station, which virtually coincides with the center of radiation of the on-board radar antenna. The use of one or another of these expressions is governed by the method for the formation of the radar images during their processing. In executing the correct photogrammetric processing of survey materials the principal requirement in the formation of panoramas from each survey revolution is the possibility of obtaining primary radar information from it. For each terrain point appearing on the radar panorama such information will be the range r from the station to the terrain point, the velocity component V_r along this direction, and also the moments in time t of station position in a survey revolution orbit corresponding to these parameters.
[47-5303]

UDC (528.94:581.52):528.711.1(202)

MAPPING OF VEGETATION RESOURCES OF ARID ZONES USING SPACE PHOTOINFORMATION

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 9, Sep 84 pp 51-56

KHRUTSKIY, V. S.

[Abstract] New possibilities for solving problems in fodder production are afforded by the use of space photographs. Using such photographs in a very short time it is possible to accomplish difficult and time-consuming work on the inventorying of pasture vegetation, the organization of rotation of pastures and evaluation of their productivity. It is possible to study vegetation resources in different climatic zones of the country, even the most remote and inaccessible. The photographs are reliable, give a detailed image and provide broad and complete coverage in small- and intermediate-scale mapping. Their high resolution and information yield make possible the compilation of such maps at scales of 1:200,000-1:1,000,000. The possibilities of the method are discussed with particular reference to the procedures used in preparation of a fodder and botanical map of the Mongolian People's Republic. The article describes the direct and indirect interpretation of the vegetation with the use of special landscape indicators. On the basis of the described principles a topoecological classification was developed. The fundamental vegetation mapping units employed were the types of pastures and groups of types of pastures. The territorial principle rather than the formation principle is applied. Using the photoimage pattern of natural territories different in structure it is possible to differentiate types of pastures which are complex in makeup from territories which are more homogeneous in vegetation. It is emphasized that data on flora makeup of the discriminated types of pastures can be obtained only on the ground, by studying vegetation in key sectors. However, any classification based solely on flora data cannot be successful in solving practical problems; it is essential to use interrelated classifications of the vegetation cover and the physiographic background. The use of space photographs affords such a possibility. Their use makes it possible to employ two approaches, analytical and synthetic, in formulating classifications and mapping of the vegetation cover. Tables 1; references: 9 Russian.
[47-5303]

/9835

NEW SPACE ADMINISTRATION 'GLAVKOSMOS USSR' CREATED

Moscow IZVESTIYA in Russian 13 Oct 85 p 3

[Text] In our country there has been formed and begun to operate the Main Administration for Creation and Use of Space Technology for the National Economy and Scientific Research -- Glavkosmos USSR. A. I. Dunayev, the chief of Glavkosmos USSR, related the following in an interview with an IZVESTIYA correspondent.

Use of space technology makes it possible to solve many problems of the national economy and scientific research with a high degree of efficiency and, in a number of cases, in a fundamentally new way.

For instance, thanks to satellite systems of radio and television communication residents of the Far North, Siberia and the Far East and other regions of the country are receiving programs of Central Television. But very long range space communication represents not just an interesting TV transmission or a telephone conversation with someone located thousands of kilometers away. It is also the timely transmission of newspaper columns and technical and other documentation. It is a very efficient means for expanding education and for propagating scientific, legal and political knowledge.

Or to take another example, it is quite apparent that systematic global observations of weather and climate would be impossible using only ground facilities. In this area meteorological satellites provide enormous assistance.

And yet another field has been added to the peaceful professions of earth satellites -- the rendering of assistance to passengers and crews of ships and airplanes which have suffered accidents. The international space system "Cospas-Sarsat" has been created based on Soviet satellites of the "Cosmos" series and specialized American satellites. The system is intended to provide coordinates of ships and airplanes in distress. At the present time over 500 people have been rescued. Canada and France are participating along with the Soviet Union and the U.S.A. in the creation and operation of this system and other countries are joining it.

In recent years various methods for studying earth's natural resources from space have been successfully developed. This work has been supported by automatic earth satellites as well as by crews of manned "Salyut" stations. Space survey of the earth's surface has become irreplaceable in geological forecasting of mineral deposits, evaluation of water resources, monitoring the condition of forests and agricultural crops, and in many other types of work.

More and more development is occurring in the field of direct production in orbit of new superpure materials and biologically active substances which are difficult or simply impossible to obtain in terrestrial conditions.

If one were to generalize the achievements in the peaceful use of space then it could be said that cosmonautics has given a powerful impetus to the development both of earth and space sciences and has yielded exceptionally high benefits for the practical activities of mankind. Therefore, the prospect for further development of Soviet cosmonautics along with the study of space also envisions the creation of long-term orbital scientific and technical-production complexes and multipurpose national economic and scientific satellite systems.

Of course, many ministries, departments and scientific organizations are interested in the efficient use of space facilities. The extent of work in space technology has now reached such a scale that the need has arisen to create a special organ to coordinate work on the creation and use of space technology for the national economy and scientific research and for carrying out the obligations of the USSR specified by agreements with foreign states and organizations.

Glavkosmos USSR will cooperate closely with all interested ministries and departments of the country. It will examine their proposals for study and exploration of space, develop prospective plans and complex programs for creation of space technology and will organize the corresponding work. Preparations and launches of space apparatus will be provided for as well as reception and dissemination of space information for practical use.

Glavkosmos USSR will also provide for conducting space operations in international programs. The USSR has been cooperating fruitfully with other countries in the field of space research for many years. In the framework of the "Intercosmos" program and in accordance with bilateral agreements more than twenty satellites of the Intercosmos series have already been launched and joint manned flights have been performed with participation of cosmonauts from the socialist countries, France and India. At present, the large international space project "Venus--Comet Halley", in which nine countries are participating, is being carried out successfully. In general, the possibilities for international cooperation in the exploration and use of space for peaceful purposes are practically unlimited.

The creation of Glavkosmos USSR is an important step aimed at the further development of work for creation and use of space technology for the national economy and scientific research, as well as in the area of international cooperation in peaceful space research.

CSO: 1866/29-P

USSR-SWEDEN COOPERATION IN SPACE RESEARCH

Moscow PRAVDA in Russian 3 Nov 85 p 4

[Article by V. Gubarev and N. Vukolov, special correspondents for PRAVDA and TASS: "The Light of the Polar Aurora"]

[Text] The dark, glassy surface of the water reflects the antennas mounted on the cliff and the building's roof, as if this is where the Earth ends and the road to space begins. This feeling is heightened when you go inside.

"If necessary, we can receive information from space," says Berd Eylertsen, who is acquainting us with what Swedish specialists are doing in space research. Calling up the required program on the computer's keyboard, he adds, "Wait a few seconds..."

The antenna slowly rotates, following the electronic dispatcher's command, and aims at a section of the sky where a satellite is now located. A cowboy movies appears on the screen, and there is no need to explain that we have begun to receive television transmission from the USA.

This is practice for future work with a telesatellite which is being created in the Scandinavian countries. Its scale model was exhibited at the Space Technology Show which took place during the Congress of the International Astronautics Federation.

"But this is still in the future," explain Eylertsen. "We are gaining experience in bits and pieces. In particular, we are carefully following the development of astronautics in the USSR. When your famous Svetlana Savitskaya visited us, we gave her a videocassette with a tape of her flight into outer space. Savitskaya worked splendidly! We have long and solid contacts with Soviet scientists, and the Viking spacecraft, of which we are justifiably proud today, could not have come about if our countries had not made numerous joint efforts."

Berd Eylertsen is one of the directors of the Viking Program. At the end of the year, a satellite is to be launched to study the upper atmosphere, where polar auroras, surprisingly impressive, but still not completely understood, originate. Viking is a joint project of several countries. Nevertheless, the burden of creating the craft lay on Swedish specialists.

"We did not have the experience," explains Eylertsen. "Swedish industry had developed some instruments and equipment, but only now have we been able to build the entire satellite. Our desire to master a technology as complex as space technology is understandable: this is the supreme technology, a new leap in engineering thinking, and, consequently, Sweden cannot sit on the sidelines of modern scientific and technical progress. But why polar auroras? Well, the entire history of the development of space research in Sweden is related precisely to this natural phenomenon...

"Intercosmos-16 was launched from the Kapustin Yar Cosmodrome. It carried a spectrometer-polarimeter developed by Soviet and Swedish scientists and manufactured in Sweden."

"The trip to the Soviet spaceport made a tremendous impression on me," says another specialist Andres Bjorkman. "Before, I had seen launches only on film, but when a powerful rocket goes up in front of your eyes, it's an impressive sight. It's a real show, and, you know, it's hard to be the director.

We remember the warm and friendly atmosphere which permeated the spaceport during preparation for the launch of Intercosmos-16. It predominated in the vehicle assembly buidling and on the launch pad, and even during off-hours, when our hosts tried to show guests from the socialist countries and Sweden the Volga and the imitable beauty of its meadows.

"We have splendid contacts with Intercosmos, with the USSR Academy of Sciences' Institute for Space Research, and with the Astrophysical Observatory in the Crimea," says Bjorkman, "and, undoubtedly, this has a great effect on development of space research in Sweden. But, unfortunately, there are only a few of us--a hundred men in Stockholm and a hundred men in Kiruna, at our Swedish 'spaceport,' as we sometimes call our institute and proving ground there. However, Scandinavian interest in space is constantly growing. This is especially evident in the fact that the university has begun to train specialists in pure space disciplines and that our specialists presented quite a few papers at the Congress of the International Astronautics Federation (IAF). This is a sign of the times: man wants to know the world around him. That means he has to know space.

The 'Swedish Spaceport,' located beyond the Polar Circle, is well-known among scientists in many countries. Here rockets are launched which carry equipment to study the upper atmosphere, and a cycle of original research in space manufacturing has begun. Swedish scientists hope that these experiments with Soviet specialists will continue. The first steps in studying the polar au ora have been taken precisely at this spaceport.

In November and December, 1976 balloons were launched from the spaceport. Winds carried them to Soviet territory and they landed in the Ural Range. The balloons carried equipment which was aimed at the polar aurora. The results were so interesting that, three years later, another series of balloons was launched. Soviet specialists, as well as scientists from France and Austria, took part in these experiments.

"Small countries play a major role in scientific exchange," says Professor Cherstin Fredga. "We are quite satisfied with contacts with Soviet specialists. In some areas, both technical and scientific, the achievements of Swedish scientists are comparable with those of countries such as the USSR, USA, and France. I must emphasize--in certain areas, not in general. I was at the initiation of our joint work with the USSR. At first these were studies of the Sun, and now the ionosphere and magnetosphere and participation in large-scale projects such as Phobos--flight to Mars and its satellite. We have already begun work on equipment which is to be flown aboard the station, and both space probes will have instruments created in Sweden. Phobos is a fantastic project. At least it seems so now, but soon it will become an everyday affair... This shows how swiftly space travel is progressing.

"We dream also of joint efforts to study natural resources," continues Fredga. "First and foremost, study of the Baltic Sea, which connects us. There is great interest in studying ice in the Baltic and in solving the sea's ecological problems. I have no doubt that we will reach an understanding with our Soviet colleagues, since this work will promote peaceful exploitation of outer space. We not only reject the ideas of 'star wars,' but our country is doing everything to prevent the militarization of space.

"I saw a photograph on the desk of one of my colleagues. Yuriy Gagarin and dozens of hands stretched out to him. The photo was taken when Yu. A. Gagarin came to Sweden and the people of Stockholm met the planet's first cosmonaut."

Here young people are working, many of whom were already born in man's space age. They dream of future flights, of new experiments which will pave the way for Earth satellites and interplanetary stations. They hope to "see the polar aurora by day" and, therefore, are enthusiastically working on their own Viking. Some of them don't hide the fact that they hope to fly in space and work there. But they remember and know the first steps into the Universe, the past joint work of our countries' scientists and specialists. This means that the space bridge to the future is sturdy: we have common goals--to make the achievements of astronautics serve man.

12809/9835
CSO: 1866/21

LAUNCH TABLE

LIST OF RECENT SOVIET SPACE LAUNCHES

Moscow TASS in English or Russian various dates

[Summary]

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
1 Aug 85	Cosmos-1670	278 km	253 km	89.6 min	65°
2 Aug 85	Cosmos-1671	310 km	210 km	89.3 min	72.8°
7 Aug 85	Cosmos-1672	290 km	199 km	89 min	82.3°
8 Aug 85	Cosmos-1673	294 km	204 km	89.2 min	64.8°
8 Aug 85	Cosmos-1674	677 km	648 km	97.8 min	82.5°
9 Aug 85	Raduga	36,560 km	--	24 hrs 36 min	1.3°
		(Communications satellite for relay of telephone, telegraph and TV programs; near-stationary, circular orbit)			
12 Aug 85	Cosmos-1675	39,342 km	613 km	11 hrs 49 min	62.8°
16 Aug 85	Cosmos-1676	371 km	178 km	89.7 min	67.2°
22 Aug 85	Molniya-1	40,638 km	656 km	12 hrs 16 min	62.8°
		(Communications satellite for long-distance telephone, telegraph and radio and for broadcast of USSR Central TV to points in the "Orbita" network)			
24 Aug 85	Cosmos-1677	280 km	255 km	89.6 min	65°
29 Aug 85	Cosmos-1678	311 km	196 km	89.2 min	82.3°
		(Data transmitted to "Priroda" State Research and Production Center)			

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
29 Aug 85	Cosmos-1679	364 km	182 km	89.7 min	64.9°
4 Sep 85	Cosmos-1680	822 km	787 km	100.8 min	74.1°
6 Sep 85	Cosmos-1681	261 km	216 km	89 min	82.4°
		(To continue studies of earth's natural resources; data transmitted to "Priroda" State Scientific Research and Production Center for processing and use)			
19 Sep 85	Cosmos-1682	454 km	435 km	93.3 min	65°
19 Sep 85	Cosmos-1683	399 km	203 km	90.2 min	72.9°
24 Sep 85	Cosmos-1684	39,342 km	613 km	11 hrs 49 min	62.8°
26 Sep 85	Cosmos-1685	379 km	209 km	90 min	72.9°
27 Sep 85	Cosmos-1686	320 km	178 km	89.2 min	51.6°
		("similar in design to 'Cosmos-1267' and 'Cosmos-1443' satellites")			
30 Sep 85	Cosmos-1687	39,342 km	613 km	11 hrs 49 min	62.8°
3 Oct 85	Cosmos-1689	663 km	574 km	97 min	98°
		(To provide data on earth natural resources and continue tests of new apparatus for sensing earth's surface and atmosphere; carries optico-mechanical and electrooptical apparatus; data goes to State Scientific Research Center for Study of Natural Resources)			
3 Oct 85	Molniya-3	40,605 km	644 km	12 hrs 15 min	62.9°
		(Communications satellite for long-range telephone and telegraph communications and for broadcast of USSR Central Television to points in the "Orbita" network)			
10 Oct 85	Cosmos-1690--Cosmos-1695	1,439 km	1,400 km	114 min	82.6°
		(Six satellites launched by single booster)			
16 Oct 85	Cosmos-1696	298 km	216 km	89.3 min	70.4°
22 Oct 85	Cosmos-1697	880 km	852 km	102 min	71°

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
22 Oct 85	Cosmos-1698	39,342 km	613 km	11 hrs 49 min	62.8°
23 Oct 85	Molniya-1	38,845 km	658 km	11 hrs 40 min	63°
	(Communications satellite for long-range telephone, telegraph and radio communications and transmission of USSR Central Television to the "Orbita" network)				
24 Oct 85	Meteor-3	1,263 km	1,235 km	110.3 min	82.5°
	(Meteorological satellite; carries optico-mechanical TV scanning equipment, radiometry equipment and instruments for geophysical studies; data goes to USSR Hydromet Center, State Scientific Research Center for Study of Natural Resources and autonomous data receiving centers)				
25 Oct 85	Cosmos-1699	364 km	177 km	89.6 min	67.3°
25 Oct 85	Cosmos-1700	35,760 km	--	23 hrs 51 min	1.4°
	(Carries experimental apparatus operating in centimeter waveband for relay of information by telephone and telegraph; circular orbit)				
28 Oct 85	Molniya-1	39,145 km	480 km	11 hrs 42 min	62.8°
	(Communications satellite for lomg-range telephone, telegraph and radio communications and transmission of USSR Central Television to the "Orbita" network)				

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29 January 1986